CEREAL SCIENCE *today*

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OF THE
AMERICAN ASSOCIATION
OF CEREAL CHEMISTS

THE NATIONAL

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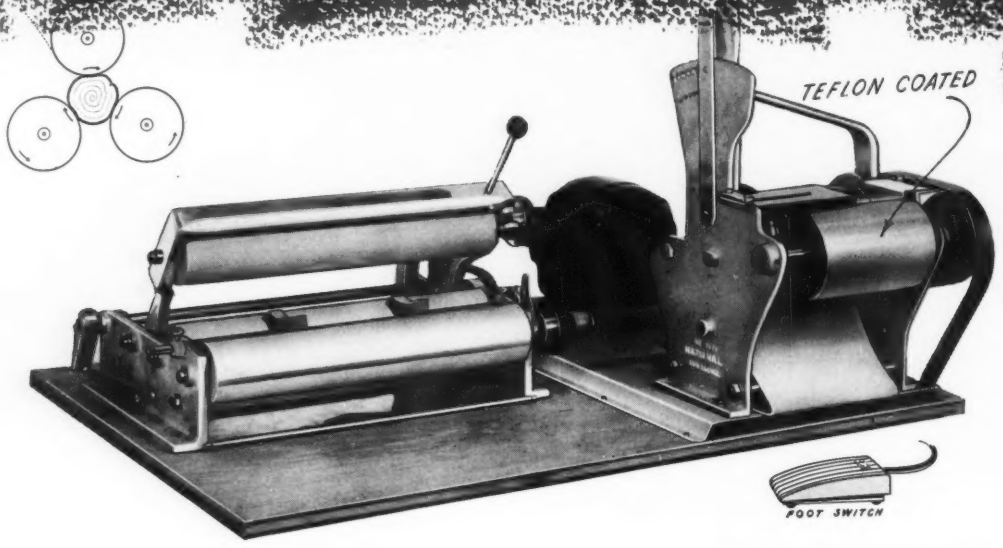
with TEFLON coated rolls

shown below in conjunction with
The THREE ROLL TYPE MOULDER



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Great advantage over all earlier models from a standpoint of fast handling of doughs. Reduced ADHESION! Relieves the tendency to use more than a "trace" of dusting flour to dough. Any operator can readily "pick" the sheeted dough off the turning Teflon Coated roll. As the dust-free sheeted dough is rolled prior to the moulding process, it will be recognized that less "moulding" is necessary to make layers adhere to each other and thereby become a homogeneous loaf-in-the-making.

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NATIONAL MFG. COMPANY

LINCOLN, NEBRASKA

The Vital Story of MILLED WHITE RICE

Enriched with Vitamins and Iron for Better Health

by Science Writer

A second "Battle of Bataan" in the Philippines has proven beyond all doubt the value of vitamin enrichment to consumers of white rice.

The famous Bataan experiment in 1948-1950 proved conclusively that whole populations can benefit from enrichment of white rice with vitamins and iron, that disease and death caused by dietary deficiencies can be overcome, that enrichment is a key to better health among infants, children and adults.

What Happened at the Second "Battle of Bataan"

Before the start of the Bataan trial, these facts were evident:

- Polished white rice is the principal food of millions throughout the world. Good food though it is, it lacks several of the key nutrients occurring in the brown rice from which it is milled, and beriberi is often common where white rice is the main food.
- In the Philippines, beriberi was common and mortality from it high.
- Beriberi is caused by insufficient vitamin B_1 in the diet. It yields when vitamin B_1 is given to its victims. It does not occur when human beings receive enough of this vitamin in their diet.
- To prevent beriberi where white rice is the the main food, vitamin B_1 must be added to the diet, either by itself or in food such as rice.
- For centuries it has been universal practice to rinse rice before cooking, hence vitamin B_1 (and any other water-soluble nutrient factor) should be added in such a way that it will not dissolve out.
- Through a process developed in the laboratories of Hoffmann-La Roche, it is possible to enrich white rice with water-soluble vitamins and iron so they will not wash off during this rinsing prior to cooking.

With these facts known, the second "Battle of Bataan" began. Through the cooperation of Philippine public agencies, the Williams-Waterman Fund, the USPHS, and Hoffmann-La Roche a controlled experiment was set up in the province of Bataan. More than 12,000 medical examinations were made, before the enrichment of rice began. Nearly 13% of those examined had beriberi.

Enriched white rice was then put into commerce in the experimental area, but not in the control area.

What happened? *Within two years beriberi was practically wiped out in the experimental zone! . . .* beriberi mortality dropped almost to zero . . . almost 90% who had symptoms of the disease before enrichment's start were free from signs of the disease or were greatly improved . . . thousands of people were helped to better health. News of the success of enrichment reached people in the control area and caused them to demand that their rice be enriched, too.

Other Countries Follow Suit

Word of the excellent results of the Bataan experiment fanned out throughout the world. The largest rice miller in Thailand marketed enriched white rice with success in 1951. In that year, also, the Puerto Rican government enacted legislation requiring that all white rice sold there be enriched, beginning early in 1952. Since then, enriched rice has been made available to the public in Cuba, Venezuela, Colombia, The Dominican Republic, Taiwan (Formosa), Singapore, and Australia.

South Carolina First To Adopt Enrichment

South Carolina, a state having high per-capita white rice consumption, requires by law that all white rice sold there be enriched with vitamin B_1, niacin, and iron, with vitamin B_2 to be included at a later date. This state has required enrichment of white flour and corn meal since 1942 and 1943 respectively.

Federal Standards of Identity Now In Force

The U. S. Food & Drug Administration established the following Standards of Identity for enriched rice which must contain at least 85% of the minimum quantities, shown below, after a rinsing test. If the method of enrichment does not permit this rinsing requirement to be met, consumer size packages must bear the statement: "Do not rinse before, or drain after, cooking."

	Milligrams per pound	
Vitamin	Min.	Max.
Thiamine	2.0	4.0
Riboflavin*	1.2	2.4
Niacin	16.0	32.0
Iron	13.0	26.0

*Optional pending further study

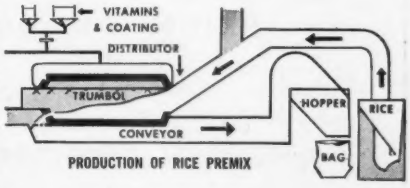
U. S. Federal Specification N-R 351 C requires the same content as the minimum standards shown above.

Popular brands of 'quick cooking' rice are now being enriched with all of the required vitamins.

How Is White Rice Enriched?

The enriching method in widest use throughout the world employs a method developed in the laboratories of Hoffmann-La Roche Inc., pioneers in the research and production of vitamins.

The Roche method impregnates rice grains with thiamine, niacin, (riboflavin, if desired), and iron and adds a final, outer coating of edible material to protect the vitamins against deterioration and preliminary washing and rinsing. For economy large amounts of vitamins are applied to small amounts of rice to make a "premix". One pound of the "premix" is then mixed with a larger quantity (usually 199 lbs.) of ordinary milled white rice at the mill.



PRODUCTION OF RICE PREMIX

What of the Future?

The trend to nutritionally-improved foods for better health is definite. The United States, a world-leader in the enrichment of white flour, white bread, corn meal and grits, farina, pastina, macaroni products, and breakfast cereals is now recognizing the need to enrich milled white rice. *When good foods are made better, everyone benefits.*

This article is part of series on the enrichment of processed cereal grain foods which are enriched for better nutrition. It is published by the Vitamin Division, Hoffmann-La Roche Inc., Nutley 10, New Jersey. An illustrated brochure containing the text of all articles in the series is available at your request without charge.

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Edited By

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1120 references

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AMERICAN ASSOCIATION OF CEREAL CHEMISTS

University Farm

St. Paul 1, Minnesota

LETTERS to the editor

MALT SUPPLEMENTATION

DEAR SIR:

The article by R. K. Durham appearing on page 166 of CEREAL SCIENCE TODAY (September 1958 issue) interested me very much. This was in regard to diastatic activity inconsistencies.

There appears to be much that is misunderstood about malt supplementation when it is used as a recommendation to correct the level to established specifications. The article interested me because of the lack of information provided the man in the field who must explain flour reports and their value in products control.

To begin with, whether or not the strength of the flour will permit the use of more or less than established specifications can probably be determined from the farinogram of the particular flour in question.

For example: a flour analysis reports a malt index of 720, a peak time of 6.5, and a Mixing Tolerance Index of 45M, with a recommendation of 2.4 ounces of malted wheat or its equivalent per cwt. of flour. The supplement recommended does not, apparently, indicate that more cannot be added beneficially. In the foregoing example the amount recommended may be sufficient and the results desirable. However, we will suppose that the flour in question is similar in analysis and recommendation for malt supplement, but has a peak time of 8.5 to 9.0 and a mixing tolerance index of 25W. In this case very possibly malt supplement, with possibly some addition of fungal enzymes of the protease type, in amounts exceeding that recommended in the flour report, will be needed to obtain the proper mellowness of dough.

In the field we are concerned with the factors that control dough development to obtain the desired internal and external characteristics in the final product. In late years fungal enzymes have been given considerable publicity as dough conditioners without consideration of the role played by malt. In view of the little work that has been published, some thought and work could be done on the effect both can have when properly balanced, in obtaining proper dough conditioning. Malt in itself would concentrate on the carbohydrates to produce dough mobility, but to the detriment of the character of the final product. Likewise, fungal enzymes of the proteolytic type would concentrate on the proteins to modify their properties, and often to the detriment of the final product. However, a balanced blend of both would avoid a concentration on either the carbohydrates or proteins, which has made the use of either alone critical.

ANDREW HABENICHT

25 Morning St.
Portland 3, Maine

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COVER: The high-speed camera, being used to photograph the opening of a cereal puffing gun, slows down motion some 200 times. By means of this research tool the effect of various physical forces of rapidly moving cover assemblies can be studied. This shot was lighted by a high-voltage flash source, synchronized with the gun explosion by placing electrical contacts on the cover to activate the camera shutter and lamps at the proper moment. Photographed by R. I. Derby, General Mills Research Laboratories, Minneapolis.

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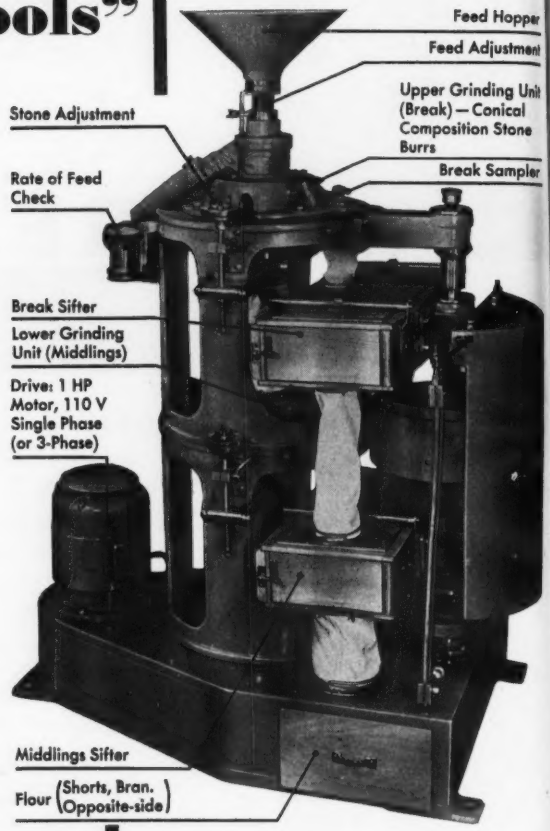

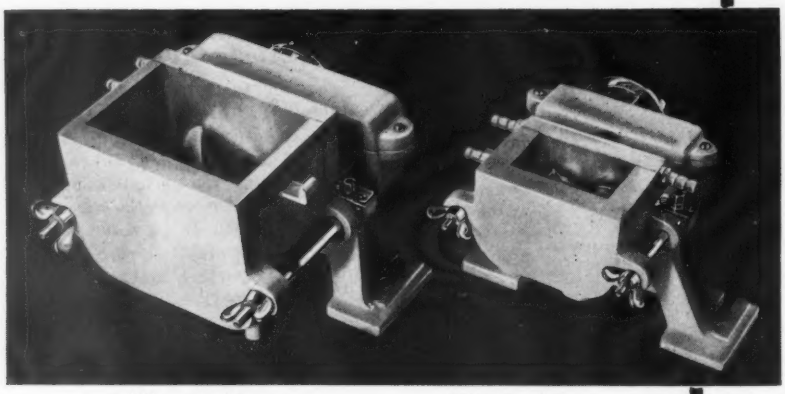

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Editorial

How much per dollar spent for dues can an individual expect to receive from a professional organization in a scientific field? Periodicals publishing research papers, feature articles, members' ideas on various subjects, and news pertinent to the field are frequently among the the most tangible returns to a member. Often an individual who belongs to one such society belongs to others also. These persons, especially, will be aware that there are differences in what a dollar buys in one organization compared to another.

There are two primary reasons for this, and one is related to the other. The first is the number of members who, through their dues, share the publication costs. Any periodical, including this one, would be fantastically expensive if only one copy were to be printed. Each additional copy spreads editorial and printing costs over a larger number. The second reason is how much advertising revenue can be obtained to further defray publication expenses. Companies with a product or service to sell to a special group place their advertising in publications that reach the largest number of their potential customers. Advertising rates go up as circulation goes up. It costs money to sell and set up a page of advertising. Thus the share as well as the amount of advertising revenue that is available to defray other costs grows with increasing circulation.

Every member of an organization publishing a periodical benefits when a new member joins. Any member who recruits a new member is enhancing the value of each dollar of dues he pays. Also, every member who promotes his society's publications among suppliers can expect to receive services far in excess of what his dues would justify.

On page 214 of this issue (President's Corner), Clinton Brooke, AACC President, reviews the decision made at Cincinnati by the members to increase the yearly dues. Mr. Brooke reminds us that even after the increase we will *still* be receiving more goods and services than could be bought by the $15.00 membership fee. It is hoped that all members who missed the Cincinnati meeting will read Mr. Brooke's report so that they will be fully informed on the AACC's financial position.

P. E. Ramstad

MAINTAINING THE MARKET FOR WHEAT FLOUR FOODS

The Wheat Flour Institute

By H. H. Lampman, Executive Director, Wheat Flour Institute, Chicago, Illinois

THE WHEAT FLOUR Institute stands as a living monument to the long-term, continuing concern of the flour-milling industry for its market.

The organization was launched in 1928, under the name National Food Bureau. Millers who subscribed were disturbed at that time over increasing attacks of food faddists and quacks upon the integrity of their product. There was also criticism by accepted authorities who advocated whole wheat products; therefore the beginning program was chiefly concerned with developing medical testimony in favor of white bread and white flour products rather than whole wheat exclusively, as the faddists would have it.

In 1935 the National Food Bureau was reorganized under its present name and brought in as a department of the national trade association of the flour-milling industry, Millers' National Federation. To this day, general policies are established by a Federation Committee. Future plans are set up and priced, with dues rates and future expenditures reviewed and approved by the Federation's Budget Committee, Executive Committee, and finally, its Board of Directors.

Expanded Services

With the new name, new dimension was added to the Institute's program, in home economics and the development of materials for use in schools. Field workers began making regular calls at colleges and universities, demonstrating the preparation of wheat flour foods from recipes and stressing traditional advantages in nutrition, economy, and mealtime variety. Editorial service was started, to help food editors of newspapers and magazines with ideas and recipes for wheat flour products.

In 1950 the program was once more reoriented, to pay greater heed to nutrition education in the schools. It was thought that public indifference to breadstuffs might be overcome if the products of wheat were made nutritionally important. The facts of nutrition could be used to ward off continuing attacks of food faddists and quacks. Finally, a nutritionally informed public would not be so easily led toward rejection of breadstuffs as "fattening" foods, but would eat a fair share of the industry's products when they were established as nutritionally acceptable, popular, convenient, and good to eat.

This year brings the fourth major change in the Wheat Flour Institute. The new program is firmly grounded on three points — a trivet of interindustry cooperation, basic research, and effective action.

Interindustry Cooperation

We start with interindustry cooperation — among wheat growers, bakers, and millers, between millers of bakery flour and millers of family flour, and among companies who use bread to help sell their products — as in National Sandwich Month. To cooperate with these groups, several assigned areas of primary interest have been surveyed. The Institute discontinued field service, leaving that area to the American Institute of Baking and to wheat growers.

With the elimination of field services and the need for school materials used by field workers, other media of communication to the public mind could be amplified. Nutrition education, as it has long been promoted by the milling industry, now falls to bakers' organizations, where the nutrition concept can be effectively extended into classrooms through field workers. At the same time, the Wheat Flour Institute assumes responsibility for a smaller but extremely influential target — the industry's ethical promotion work among doctors, dentists, and public health workers.

As it now shapes up, the Wheat Flour Institute's efforts are exerted through four departments: Home Economics-Editorial service, headed by Miss Ruth Behnke; Testing Kitchen, with Mrs. Kathryn Adams as director; Public Health Services,

The Testing Kitchen of the Wheat Flour Institute is the scene of constant production — new recipes and menu ideas, dishes all using products of wheat. Here, a staff home economist removes a pan of biscuits from the oven. This was a standard test employing a sample of flour just received to determine baking characteristics before used in "new recipe" development.

under Mrs. Rae Theimer, director; and Merchandising and Promotion, directed by Mr. John Sherlock, Jr.

In these four departments and throughout the organization, the basic creed is service — to millers, bakers, wheat growers, professional groups, related food industries, and to companies and organizations who share the same goal. Whenever possible, areas of common interest are developed, whether it be nutrition facts, merchandising through National Sandwich Month, the promotion of self-rising and family flour, expansion of the domestic market for cereal products, or the effort to stimulate greater use of commercially baked foods.

Two Main Channels

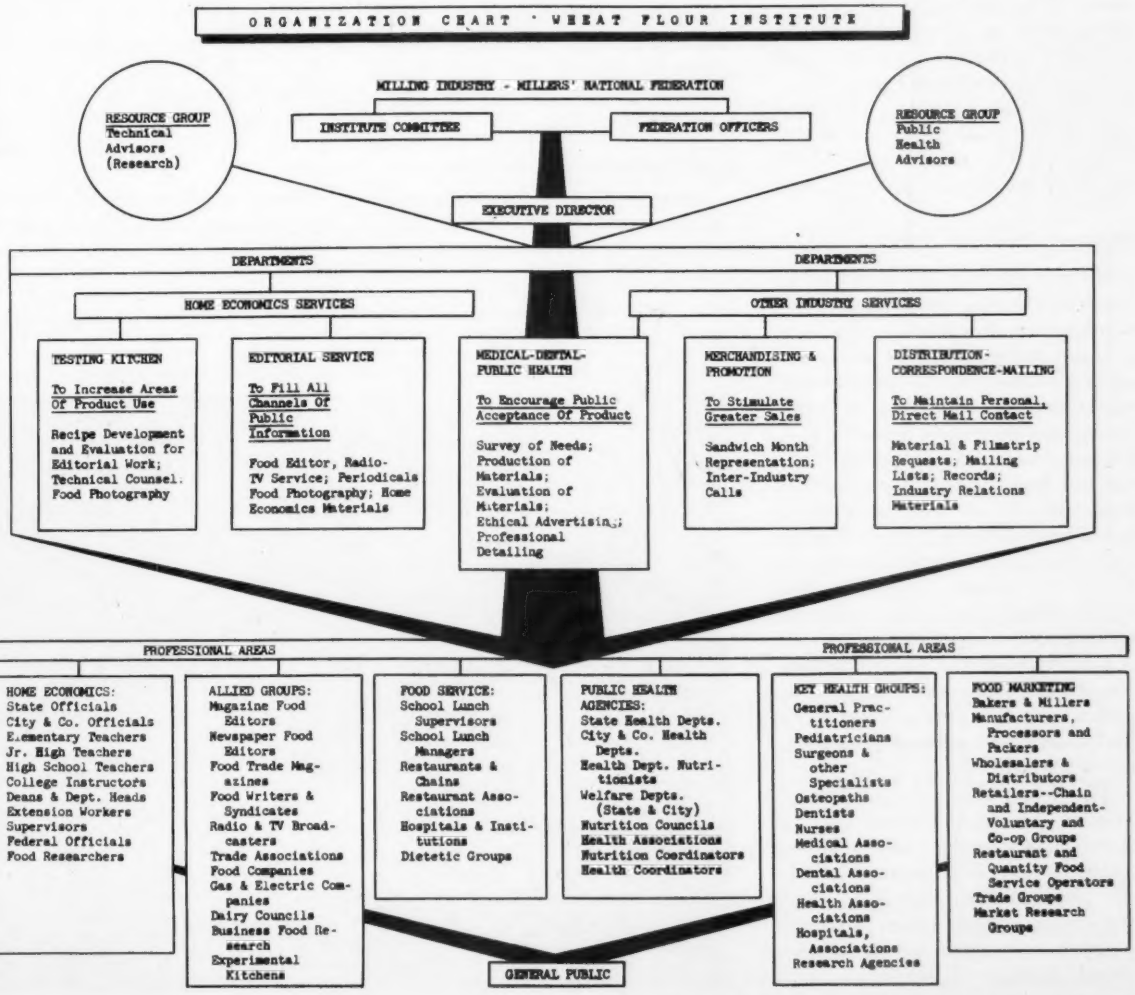
The method of Institute operation is important. The Institute follows two main channels toward its one goal, which is to increase the market for all wheat flour foods, no matter what their form.

First, the Institute develops new ideas for product use — namely, recipes. Hundreds of recipes are offered each year, to be reprinted or circulated by actual count millions of times. Each recipe — reprinted, heard on the radio, demonstrated on television, or used by a homemaking teacher or student in a home-economics class — suggests a new way of use for the products of wheat.

The second channel aims toward those people who are indifferent or even antagonistic toward wheat flour foods. The Institute attempts to reach these people through channels of accepted authority — professional people like doctors, dentists, and public health workers. In this way the program attempts to gain understanding; then, perhaps, appreciation of wheat flour foods; and at last, through understanding, acceptance — and thus, greater use.

Every phase and expression of the Institute program tells one or more points in the same basic-product story. Wheat flour foods are convenient and available; popular because they're good-tasting; economical; traditionally accepted, a mealtime habit; nutritionally recommended; and finally, they are "go-together" foods with other good things to eat.

What other foods, weighed on the scales of this basic-product story, can match the strength of the claim of wheat flour and bread products to greater consumption? None, it is believed. No group of foods has a better claim to increased use. Furthermore, the products of wheat do not displace other foods on the family table or the shelves of the supermarket or grocery store. They are "good companions" to other foods. They supplement; they add to eating pleasure. This dual approach to the market, and the advantages of wheat flour foods, constitute the fabric of the Institute's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ALLIED GROUPS: Magazine Food Editors Newspaper Food Editors Food Trade Magazines Food Writers & Syndicates Radio & TV Broadcasters Trade Associations Food Companies Gas & Electric Companies Dairy Councils Business Food Research Experimental Kitchens
FOOD SERVICE: School Lunch Supervisors School Lunch Managers Restaurants & Chains Restaurant Associations Hospitals & Institutions Dietetic Groups
PUBLIC HEALTH AGENCIES: State Health Depts. City & Co. Health Depts. Health Dept. Nutritionists Welfare Depts. (State & City) Nutrition Councils Health Associations Nutrition Coordinators Health Coordinators
KEY HEALTH GROUPS: General Practitioners Pediatricians Surgeons & other Specialists Osteopaths Dentists Nurses Medical Associations Dental Associations Health Associations Hospitals, Associations Research Agencies
FOOD MARKETING Bakers & Millers Manufacturers, Processors and Packers Wholesalers & Distributors Retailers--Chain and Independent-Voluntary and Co-op Groups Restaurant and Quantity Food Service Operators Trade Groups Market Research Groups
GENERAL PUBLIC

program, expressed in all departments.

Developing New Product Uses

Work toward new product uses begins in the testing kitchen, where new recipes and new ideas for food combinations or the serving of foods are developed for the Self-Rising Flour Institute, the Durum Wheat Institute, the regular Wheat Flour Institute program, and National Sandwich Month.

Going to the editorial department, the testing kitchen's basic idea is translated into story or picture, or both, often in appetizing full color. Mailings are regularly made to food editors and writers, radio and television programmers, magazines, and other home economists and publishers. Through these media, month by month, the total audience for the wheat flour story is enlarged by many millions.

The home economics staff in itself serves as an agency for the milling-baking-wheat growing industry. The fraternity includes top magazine and newspaper food editors, writers, home economists in business, classroom teachers, extension workers, and representatives in many other areas served by the Wheat Flour Institute.

National Sandwich Month

Home economics works as well in Sandwich Month, where professional relationships are maintained to supplement and expand the impact of annual promotion. Sandwich Month represents a new concept of merchandising as well as new ideas in food. The success of the promotion testifies to a basic truth — that people eat food and meals, not products by brand name. Accordingly, otherwise competing companies such as Swift, Kraft, Campbell, Armour, Best Foods, Ward, and Continental; and leading store organizations such as A & P, National Tea, Jewel, Red Owl, Kroger, and many others all work together to fit their products into America's most popular eating pattern, the sandwich meal.

The Wheat Flour Institute serves only as coordinator, not sponsor, of this annual August merchandising event. Its success is demonstrated by the fact that each year the nation's top names in food enlist as participant sponsors, returning for another round. Millions of dollars are spent in advertising for sandwich meals in August. Each sponsor sells his own products — but *all* sell sandwiches. While everyone sells his food, he also sells the advantages of complete sandwich meals. And nothing, finally, sells bread as sandwiches do.

Public Health Services

The newest department in the Institute organization, offering a campaign in the medical-dental-public health field, is tagged for brevity, "Public Health Services." This program too reflects the total Institute effort, but especially aims at changing public attitudes. The minds of doctors, dentists, nurses, and public health workers are the objective because these people, in turn, influence nearly everybody.

The program is based on service — to help doctors, dentists, and public health workers in their own plans for patients and communities. The Institute offers help to teach the public that good diet requires a share of wheat flour foods; help to combat negative professional counsel against wheat flour foods; and help for professional groups fighting food faddism and quackery.

New Publications Under Way

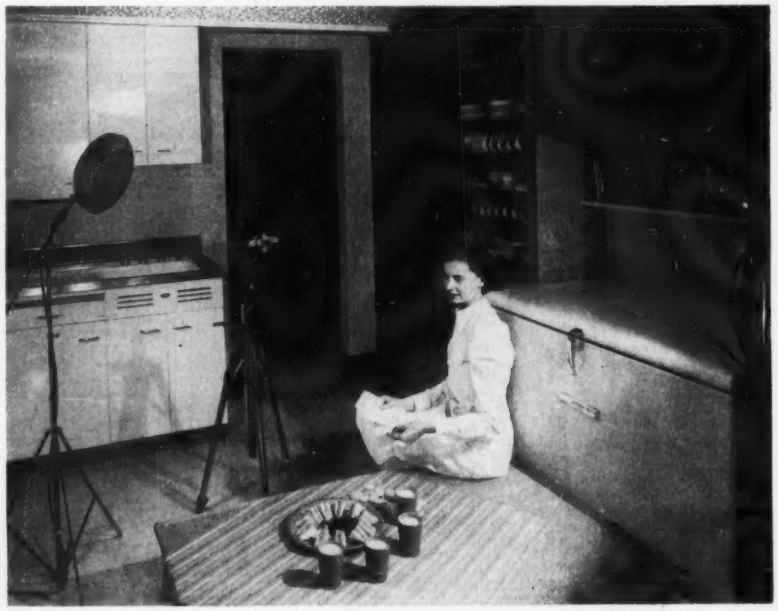
More specifically, the Institute attempts to reach the minds of doctors indirectly or *en passant*. Two proposed new pieces of material illustrate the point.

A survey of physicians indicated a need for a simple, capsulized statement of the most important considerations in nutrition. Physicians asked for such a booklet. At the same time, the general practitioner who does not have available the services of a dietitian or a diet kitchen stands in constant need of therapeutic diet lists, which he can give to patients with common specific ailments. Combining these two thoughts, the Institute staff plans a "Handbook of Therapeutic Diets." Such a booklet will be prepared with the technical assistance of authorities in the field, and produced to the satisfaction of the Council on Foods and Nutrition of the American Medical Association. Availability of the booklet will be advertised to the profession.

A proposed leaflet on "Snack Foods" also illustrates the approach. Such a booklet was suggested by Perry Sandell, Director of the Bureau of Dental Health, American Dental Association. Mr. Sandell said he constantly receives requests for such material from dentists who want to help guide their patients to improved diet as a step toward eliminating tooth decay.

Neither of these pieces of material would "preach" to physicians or dentists — yet both would be authorita-

Much time of staff home economists goes into the creation of appetizing food photographs, full color as well as black and white, for food editors throughout the country. Attractive photographs of wheat flour foods win generous space assignments in women's feature sections of newspapers and magazines, company publications, cookbooks, and federal agency bulletins.



tive and would exert considerable influence on professional attitudes.

As an index to the size of the public health market, consider that doctors see an average of 35 patients per day, a total of 4,487,875 daily visitors. The new program for the people in this influential area will employ ethical advertising in professional journals; direct-mail materials for use by doctors, dentists, and nurses; and professional detailing, or personal calls on key people in public health.

A number of Institute materials are already at work in the public health area. The film strip, "Judy's Family Food Notebook," has been purchased by public health departments, to help teach children and grown-ups how to eat for better health. A basic nutrition fact book, "Eat to Live," has been ordered by many doctors, nurses, and public health social workers. A weight-control diet, "Common-Sense Weight Reduction," has been circulated among doctors and reordered by the thousands, helping to promote wholesome attitudes toward food of all kinds. These materials and others originally prepared for nutrition education in schools may be transferred to the new program.

Additional projects are being planned for school doctors, school nurses, family physicians, dentists, specialists prescribing diet, and other public health workers. Here again, the Institute paves the way for greater acceptance and use of products by attacking the problem of public antagonism or indifference through the medium of doctors, dentists, and public health workers.

Basic Aims

Fundamentally, the Wheat Flour Institute is striving to create and promote public appetite for wheat flour food in all its forms. When we get people to eat one kind of wheat food, they eat another and another. Variety itself increases consumption.

Another point on the triangle, basic research, has been neither neglected nor ignored. Everything indicates that there is great hope and great promise in the future from research. Specific plans in this area will be developed from our experience in public health services.

Wheat flour foods may at last come into their own for values in protein, as well as B-vitamins, calcium, and iron. We already know they are low in fat and low in cholesterol. And in market research, each day we are learning more about how America eats and why.

Appetite for wheat flour foods is created through tempting photographs released regularly to food editors for publication throughout the country. This is one of the collection of nearly 3,000 food pictures that have been produced by Wheat Flour Institute.

Such is the plan of the Wheat Flour Institute. The future will demonstrate its worth, as past experience has proved the wisdom of industry in establishing it. The Institute provides a program for promoting basic products — leaving individual mills free to accomplish the job of telling their own story of the merits of individual brand-name products.

Future Unlimited

The Wheat Flour Institute's progress over the years reflects many changes in science, in population, in public attitudes and social organization. With the enrichment of white bread and flour during World War II and its continuation today, the question of whole wheat versus white flour products is fairly well settled. Enrichment itself was prepared for by new discoveries in science and the synthesization of vitamins.

Developments in vitamin research were followed by what some authorities have called the protein era in which the products of wheat may yet score their greatest gain. Finally, we are moving into a climate where preventive medicine looks more and more to food supplies, their quantity and quality, and the balance of nutrients to calories. The industry comprising wheat growers, millers, and bakers may be on the verge of its golden age.

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AN EXPERT'S VIEWS ON THE

Potential Industrial Use of Amylose

By Paul Kaplan, Stein, Hall & Co., Inc., New York, N. Y.

AMYLOSE IS A fascinating material with an exciting future. We welcome this opportunity to summarize the work on its applications so far, and to tell you something about prospects for the future. Although much of what I am to say is based on work that has been carried out with amylose produced by a patented starch fractionation process developed by the Dutch Potato Cooperative, AVEBE, of Veendam, Holland,[1] it should also apply to amylose from any source.

Dutch Fractionation Process

Readers who are familiar with the processing of starch may be interested in a brief history of the AVEBE fractionation process.

As early as 1904 (4), the fractions of starch were separated experimentally. The first practical laboratory fractionation method was the butanol precipitation method, worked out by T. J. Schoch almost twenty years ago (5,6). Since that time Dr. Schoch and a number of other workers have developed modifications of the separation process based on Dr. Schoch's original principle (1,2,7). The properties of the separate fractions obtained by these laboratory methods appeared to be extremely interesting; however, none of these fractionation methods proved to be suitable for commercial production.

Shortly after World War II, the Dutch firm AVEBE recognized the commercial possibilities of amylose and amylopectin and sponsored a joint research project with the National Council of Industrial Research (commonly known as T.N.O.) in Delft, Holland, to develop a commercially feasible fractionation process. This work was carried out by P. Hiemstra of AVEBE, W. C. Bus, and J. M. Muetgeert, in Delft. After many years of work an entirely new method of fractionation was developed[2] (3). The method involves relatively simple processing techniques, and AVEBE is now regularly producing substantial quantities of amylose and amylopectin from potato starch.

The process is based on the specific interactions of amylose and amylopectin with concentrated salt solutions, in particular the sulfates of magnesium, ammonium, and sodium. The Dutch process uses a 13% solution of magnesium sulfate in which the starch is dissolved at high temperatures. The amylose and amylopectin subsequently separate from the solution upon cooling. A complete history of this development and details of the process were published in *Die Stärke* in 1956 (3). Patents have been granted on this process in a number of countries, and others are pending in the United States. Our company has an exclusive arrangement with AVEBE to sell amylose and amylopectin in the United States and Canada, and we have a cooperative research program under way with AVEBE and T.N.O. for developing applications for amylose and amylopectin.

Properties and Possibilities

In order to get a clear picture of the potential industrial use of amylose, we should review its basic properties and possible economic advantages. Some of the more important ones are:

1. Amylose is chemically quite similar to cellulose. The principal difference is that the d-glucopyranose units of amylose are joined by 1-4 alpha linkages, whereas the d-glucopyranose units of cellulose are joined by 1-4 beta linkages.
2. Amylose has excellent film-forming and high film-strength properties.
3. Amylose forms grease-resistant films and coatings.
4. Amylose can be easily solubilized by heating under pressure and does not require elaborate chemical solubilization techniques.
5. Amylose solutions can be made viscosity-stable for extended periods of time.
6. Amylose can be easily cross-linked and insolubilized.
7. Amylose is a natural pure food material and is readily digestible.
8. Amylose is lower in price than other film-formers of comparable strength.
9. Amylose will readily form esters, ethers, and other derivatives.
10. Amylose readily undergoes secondary bonding reactions with other polyhydric materials.

Amylose Films and Fibers

The similarity of amylose and cellulose immediately suggests many possible uses. The most important of these in terms of potential volume is, of course, the production of films and fibers. Probably the first work of this nature was carried out by the laboratories of the Northern Utilization Research and Development Division at Peoria, Illinois, where studies were initiated on the separate fractions of starch shortly after Dr. Schoch's original fractionation work was published. Since that time, work on the

[1] U. S. Patents: 2,829,987; 2,829,988; 2,829,989; 2,829,990; and corresponding foreign patents.

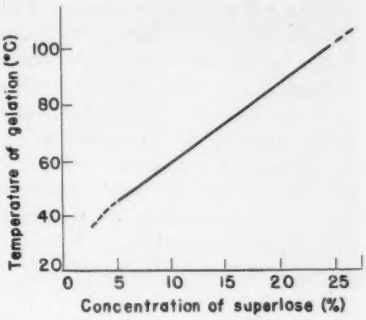
[2] See footnote 1.

possible use of amylose and its derivatives in the manufacture of films and fibers has been under study by the Northern Utilization Laboratory[3] (8,9,10,11,12). The individuals who have worked on these problems are too numerous to mention, but they are undoubtedly well known to most cereal chemists.

Drs. Hiemstra, Bus, and Muetgeert have also done a great deal of work on the production of amylose films and fibers. Their first problem was that of preparing a suitable solution, since undegraded amylose will not form solutions in water at the boiling point. While we understand that samples of high-amylose corn have been grown that will gelatinize below 100°C., the only type that we have seen is one that was supplied to us by J. W. Evans of American Maize-Products Co. This type of high-amylose corn requires temperatures above 100°C. for gelatinization.

To make a solution of the amylose that we are marketing today, it is necessary to heat it in water to 130°C. for 10 minutes. This, of course, requires heating under pressure. Higher temperatures can be used with correspondingly shorter heating times. Since degradation will take place quite rapidly at such an elevated temperature, a continuous heat-exchanger is preferred over an autoclave or batch-type apparatus. Accordingly, Drs. Hiemstra, Bus, and Muetgeert, in their work on producing amylose films, have employed a continuous heat-exchanger designed so that dwell time at the gelatinization temperature is not more than 5 minutes. We have since discovered that a Votator is ideally suited for preparing amylose solutions. This device, which is widely used in the textile, paper, and food industries, is a scraped-film type of continuous heat-exchanger manufactured by the Girdler Corporation, Louisville, Kentucky. A typical amylose cooking set-up is shown in the accompanying diagram. Two Votator units (*A* and *C*) are used, one for heating and the other for cooling, with a holding chamber (*B*) between the two units to obtain the desired dwell time. There are other heating devices that should be suitable for making amylose solutions; the Farley Cooker used by the candy industry has been suggested as one type.

Amylose solutions retrograde rapidly and will gel quickly after cooling below a critical gelation temperature. As the first graph indicates, this temperature is dependent upon the concentration of amylose. It is necessary to go below 25% concentration to have a critical gelation temperature below the boiling point of water.

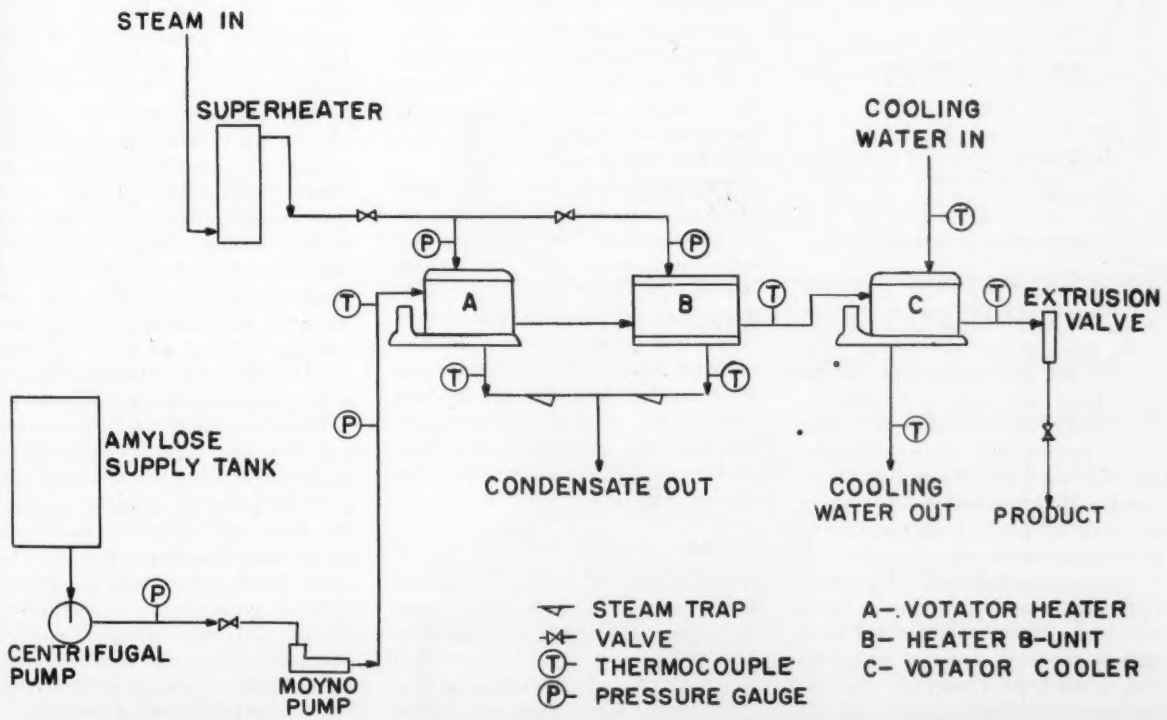


Temperature of gelation vs. concentration of superlose solutions.

Films cast from straight amylose solutions are strong and transparent. It is not practical, however, to produce films commercially using this technique; the solutions are so sensitive to variations in temperature that they are difficult to handle.

[3] U. S. Patents: 2,608,723 and 2,656,571.

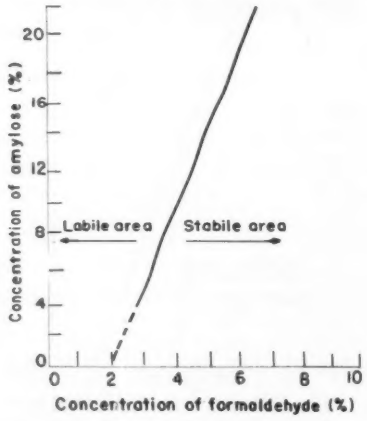
Diagram of typical amylose cooking process.



Stability of Solutions

Drs. Muetgeert, Bus, and Hiemstra therefore tackled the problem of preparing stable solutions of amylose that would remain fluid so that they could be handled by conventional casting and coating techniques. They discovered that by adding formaldehyde to the amylose slurry before heating, they could produce amylose solutions that are viscosity-stable. It is believed that the formaldehyde acts by forming a hemiacetal with amylose, thereby preventing the hydroxyl groups on neighboring amylose molecules from reassociating.

The quantity of formaldehyde required for stability is dependent upon the concentration of amylose (second graph). A 20% amylose solution containing 7% formaldehyde will remain fluid for months, and we are today marketing formaldehyde-stabilized amylose solutions. It should be noted that where stability of a few minutes to 24 hours is required, considerably lesser amounts of formaldehyde will suffice. This may be adequate for most commercial uses. Patents on this discovery are pending.



Effect of formaldehyde stability of superlose solutions.

By varying the film-casting techniques and post-processing of the film, films cast from formaldehyde-stabilized solutions can be made either water-soluble or water-insoluble. The amylose films can be plasticized with glycerine and coated in the same manner as cellulose films to produce moisture-vapor barriers.

The basic advantages of amylose to the film manufacturer are its lower cost, the simpler solubilization techniques required, and its pure-food and digestibility properties; the latter property strongly suggests its use in sausage casings and other food wrappers. Work is actively under way on these specific end uses.

Most of the leading film manufacturers in the United States and Europe are now carrying out laboratory investigations on the use of amylose, and we hope that before too long amylose films will be commercially available. Particularly promising is the production of water-soluble films. As special packaging material for water-dispersible products, such as dyes, detergents, insecticides, and industrial chemicals, these could replace more expensive water-soluble polyvinyl alcohol films that are now on the market.

Exploratory Work

Since amylose readily forms esters, ethers, and other derivatives, exploratory work has been carried out on chemical modifications of amylose. As previously noted, the Peoria laboratories have done a great deal of work in this area, particularly on the use of derivatives in film and fiber manufacture. It is quite possible that, after further exploration, derivatives of amylose may well prove to be superior for some of the uses just outlined. Some of the derivatives may even result in products with unique properties.

Several months ago Dr. Muetgeert was successful in making fibers from amylose, by solubilizing amylose with caustic and then using a coagulation bath of ammonium sulfate solution. He has produced these fibers in the laboratory at rates of 110 meters per minute, and has also made amylose films using this technique.

The outstanding film-forming properties of amylose, its ability to be easily insolubilized, and its lower cost when compared to other film formers should make it an excellent material for coating and surface treatment of paper and paper products. Amylose coatings are grease-resistant, and since amylose is a natural pure-food material the coatings should be particularly well suited for paper food containers and paperboard used for food packaging.

Textiles

Starch has, of course, been used for centuries as a sizing and finishing agent for textiles. Since amylose has the properties of conventional starch plus the ability to be easily insolubilized, it offers good possibilities as a permanent finish for fabrics.

Another important potential application for amylose in the textile field is as a binder in the manufacture of nonwoven fabrics. For this, good film-forming properties, high film strength, and good water resistance are required. Amylose meets all of these requirements and is considerably cheaper than the polyvinyl chloride and polyvinyl acetate emulsions now being used.

Potential Applications

While little work has been done so far on gel properties, we believe amylose is well suited for uses in which controlled gelation or quick-setting, stiff, irreversible gels are required.

The Commission on Increased Industrial Use of Agricultural Products, created by the 84th Congress, has recommended a research program which includes an evaluation of amylose for industrial uses. As potential applications they suggest the use of amylose in conjunction with wood pulp as an integral part of paper, as an additive to paper and paper products, as a base for ester-type plastics and special chemicals, and in the preparation of films.

Problem Areas

Now let me mention briefly two fundamental problem areas where new technical developments could greatly aid in speeding up and expanding the industrial use of amylose: plasticizing and water-insensitivity.

Within certain limitations, amylose can be plasticized with humectants such as glycerin. But humectants increase water-solubility, they lower film strength, they vary in efficiency under varying climatic conditions, and their effect is not permanent. A plasticizer is needed that will permanently plasticize amylose films and coatings without adversely affecting the strength and water-solubility or water-sensitivity of the amylose.

Films cast from straight amylose solutions are water-insoluble. These films will, however, absorb water with a resulting loss in strength. Although the films can easily be made relatively water-insensitive, they also become brittle. Since wet strength is often a requirement, a method of making films and coatings of amylose water-insensitive yet flexible would be a significant contribution furthering the industrial use of amylose.

Prospects As of Now

The solutions to these key problems, plasticizing and water-insensitivity of amylose, could well make the difference between just an interesting specialty or a large-volume basic material. These areas certainly afford an opportunity for productive and rewarding research.

Until recently, work on amylose has consisted primarily of government-supported research programs, academic studies in universities, and laboratory investigations by processors of starch. However, with the present greater availability of amylose, chemists and engineers in a great variety of industries are working with this new material, not only on the applications I have mentioned but on many others. The sponsorship of work on the breeding and processing of high-amylose corn by the Corn Industries Research Foundation, as well as the program recommended by the Commission on Increased Industrial Use of Agricultural Products, will serve to further stimulate the interest of possible consumers. We are confident that many uses will be found and that amylose, whether it be produced by a fractionation process or by the breeding and growing of high-amylose corn, will be consumed in substantial volume in the not too distant future.

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FLOUR MILLING

CHANGING FLOUR PROTEIN CONTENT

The process and principle of making flours differing appreciably in protein content from the wheats from which they are milled were described by David G. Elias of Henry Simon, Ltd., in a recent lecture delivered before the Norwegian Section of the Scandinavian Cereal Chemists' Association.

Mr. Elias pointed out that in normal milling, endosperm cells break up differently, depending upon the nature of the wheat. In hard wheat, cells break across but persist as recognizable grits; in soft wheats the cell contents spill out in irregular masses (see Fig. 1).

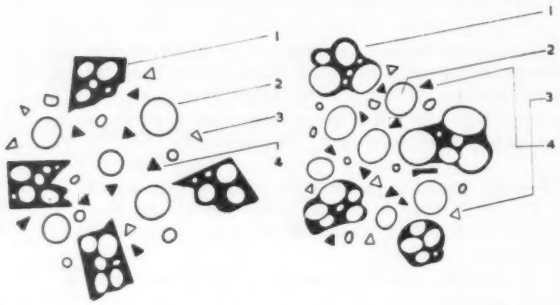

Fig. 1. Diagrammatic comparison of hard (left) and soft wheat flours (right), showing: 1, endosperm agglomerates; 2, starch granules; 3, broken starch; 4, broken matrix.

Particles from 40 microns up are largely endosperm aggregates. Those between 15 and 40 microns are largely starch granules and the protein content is lower than that of the whole flour. The fraction below 15 microns consists of small and broken starch granules and broken protein matrix. The protein content of this portion is therefore high.

To separate fractions differing appreciably in protein content requires separations at cut-points such as 15 and 40 microns. This is below the range where normal sifting separations can be made. Even when very fine clothing of sieves is used, the very fine particles adhere preferentially to the large aggregates, so that the fine fraction is lower in protein than the tailings fraction.

A simple aspirator could be used, but it would be inefficient and would lack capacity. Practical separation requires use of forces thousands of times greater than gravity. This is done in a centrifugal air-classifier in which air-drag forces are counterbalanced by centrifugal forces to give the required cut-points at reasonable air and stock capacities.

A simple volute chamber, as shown at the top in Fig. 2, illustrates the principle. However, because air speed cannot be constant, owing to frictional losses on the walls, the cut-point is not sharp enough. This difficulty is elim-

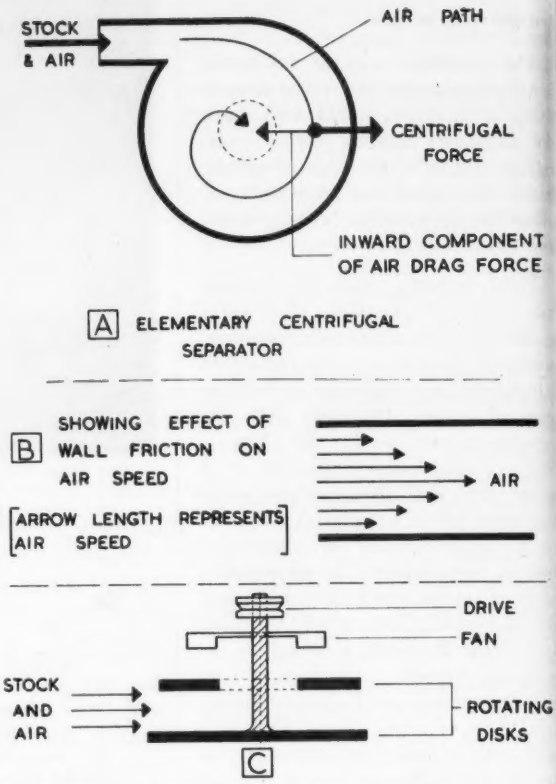

Fig. 2. Basic principles of the centrifugal air classifier, showing the "moving wall" principle.

inated by spinning the walls of the chamber at the same speed as that of the air. Particles smaller than a certain size go out through the fan; larger particles remain outside the classifying zone and are removed. The critical size depends upon the dimensions of the classifying chamber, the quantity and speed of the air, and the density of the stock.

Mr. Elias called attention to the improved efficiency that would result if the aggregate fraction over 40 microns were reduced to its component parts before classification. He went on to show that grinding these agglomerates on a roller mill breaks starch granules to a degree that adversely affects baking quality, and these small starch pieces dilute the protein content of the fine fraction. Certain types of impact grinding accomplish the desired size reduction without a significant increase in starch damage.

Combining the proper grinder with the classifier brings about improvement in efficiency of the protein displacement system. Wheats vary in the degree to which fine grinding of the coarse fraction is economically feasible. Even some of the agglomerates in soft wheat flour have hard wheat properties.

With the process it becomes commercially possible to make flours with from half to double the original protein content. Blending can provide any level in between.

Mr. Elias concluded by suggesting that flours with protein contents as high as 40% and as low as 2% may be produced and have specific value in the markets of the future.

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BOOK reviews

A Guide to the Literature of Chemistry, by E. J. Crane, Austin M. Patterson, and Eleanor B. Marr; 2nd ed., 397 pp. John Wiley & Sons, Inc., New York, 1957. Price, $9.50. **Chemical Publications: their nature and use,** by M. G. Mellon; 3rd ed., 327 pp. McGraw-Hill Book Co., Inc., New York, 1958. Price, $7.00. Reviewed by GERTRUDE BATTELL, University of Minnesota.

Two standard texts and reference books have been brought up to date, Mellon in its third edition and Crane in its second. The professional status of the authors makes any comment about their qualifications superfluous. Crane was the pioneer, having published the first comprehensive survey of the literature of chemistry in 1927; Mellon followed soon thereafter, in 1928.

Although these books parallel each other to a considerable extent, they are also supplementary because each approaches its task from a different point of view and each includes information not found in the other. Every chemistry library should have both volumes and every library including science in its collection should have one or both. Individuals may wish to choose between them for personal use. To a librarian Crane's approach seems more usable because it is the one librarians usually adopt when instructing students, both undergraduates and graduates, in the use of a library; i.e., from the general to the special. It begins with general reference books, ranging from encyclopedias to monographs, and proceeds to journals, abstract publications, and more specific sources. Perhaps to scientists, and especially to those with extended experience in research and scientific literature, Mellon's approach is preferable. Certainly it is a logical scheme and carefully carried out. After an introductory chapter dealing with the various types of information which may be reasonably sought in a chemistry library and a brief history of the development of chemical literature, he divides his material into primary, secondary, and tertiary sources. Under each category he discusses in detail the various kinds of publications available. The final chapters are devoted to literature searches and examples of library problems, with sample class assignments for each problem.

Crane is particularly useful because of his lists of sources and a series of appendixes, including 1) literature relating to chemical literature; 2) symbols, abbreviations, and standards used in chemical literature; 3) libraries; 4) a bibliography of lists of periodicals (he omits the important 1953 supplement to the U.S. Department of Agriculture Library *List of Serials Currently Received in the Library of the U.S. Department of Agriculture;* 5) scientific and technical organizations; 6) periodicals of chemical interest; and 7) dealers and publishers.

As a minor point, Mellon's book is in a much more attractive format than the earlier edition. There is no need for textbooks to look dull and stodgy. Crane's is also a handsome volume. Both books appear to be well indexed and errors are few. A glaring, though unimportant one, in Crane is in the preface where the chapter "Procedure in literature searches" is referred to as Chapter 8 instead of Chapter 10.

All librarians as well as all chemists, whether beginners or experienced, should be extremely indebted to these authors for their enormous contributions to the documentation of a rapidly expanding field.

• • •

Oral Communication of Technical Information, by Robert S. Casey; 199 pp. Reinhold Publishing Corp., New York, 1958. Price, $4.50. **Better Report Writing,** by Willis H. Waldo; 231 pp. Reinhold Publishing Corp., New York, 1957. Price, $4.75. Reviewed by P. E. RAMSTAD, General Mills, Inc., Minneapolis, Minn.

These two brief volumes deserve to be read and studied by every chemist who is expected in the course of his work to describe or explain to someone else what he is doing. Both authors are chemists who appreciate the needs and problems of the chemical worker who wishes to communicate effectively. The books are complete, yet concise. They could be used as texts by students, but they are organized in a manner that makes them useful as reference books.

Casey's book encompasses all forms of oral communication — formal papers presented at scientific meetings, exchange of information within and outside an organization, talking science to laymen, giving technical legal testimony, and even tips on social conversation. He discusses the psychology of effective communication, the steps in preparing a report, how to deliver a speech, use of audio and visual aids, and presiding over meetings.

Better Report Writing comes out of the experience of the author as a technical editor with the Monsanto Chemical Company. Emphasis is on the type of report written to communicate technical information within a company. It is likely to be most useful as a guide for "polishing up" and putting a report into final draft. It is more concerned with the mechanics of organization, grammar, and punctuation than with how to make report writing easier.

• • •

Compilation of Labeling Laws and Regulations for Hazardous Substances, prepared by John D. Conner and Robert L. Ackerly; 114 pp.; publisher, Chemical Specialties Manufacturers Assoc., 50 E. 41st St., New York 17,

N.Y.; price $5.00 postpaid. Covers the laws in 16 states and cities, the Federal Caustic Poison Act, and CSMA "Model Hazardous Substances Labeling Act for Retail Packages." Pages are punched for a standard three-ring binder and the cover is removable for inserts of new laws and additions, which will be offered as prepared, at prices depending on the number of pages.

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New Journal of Toxicology and Applied Pharmacology. Announcement is made in "What's New in Food and Drug Research" of the coming publication of this journal beginning in January, 1959. It will publish articles on chemicals, drugs, and food additives with emphasis on studies designed to establish their safe usage. The journal will be under the editorial supervision of Harry W. Hays, Toxicological Research Center, National Research Council; Frederick Coulston, Sterling Winthrop Research Institute; and Arnold J. Lehman, Division of Pharmacology, Food and Drug Administration.

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Ernahrungsforschung. Berichte und Mitteilungen aus dem Institut fur Ernahrungsforschung und der Anstalt fur Vitaminforschung Potsdam-Rehbrucke. (Nutrition research.) Reports and communications from the Institute of Nutrition Research and the Institution for Vitamin Research, Potsdam-Rehbrucke. v. 1 no. 1- 1956- Berlin, Akademie-Verlag DM 3.20. Original papers on the chemistry of foods and nutrition, as judged by the one issue examined. No English summaries.

• • •

Soil — the 1957 **Yearbook of Agriculture,** for sale by Superintendent of Documents, Washington 25, D. C. Price $2.25. Many experts in the fields of soil science and soil management have contributed to this volume. Chapters are grouped under these headings: Principles; Fertility; Practices; Soil care; Moisture; Systems; Regions; Special uses. Of special interest to cereal chemists are chapters on soil management and cdop quality, the Northern Great Plains, the winter wheat and grazing region, the Pacific Northwest wheat region, grasses, and managing soils for rice-growing.

• • •

Official Grain Standards of the United States — Service and Regulatory Announcement AMS-177 — describes all current federal grain standards, including the recently revised wheat standards, and important features of grain inspection. For sale by Supt. of Documents, U. S. Gov't Printing Office, Washington 25, D. C. Price 35 cents. Testing Wheat for Quality by BYRON S. MILLER and JOHN A. JOHNSON, was recently issued as Production Research Report No. 9, U. S. Dept. of Agriculture. This 16-page bulletin deals with quality characteristics of hard red winter and hard red spring wheats and their importance to farmers, millers, and bakers. Physical, chemical, and baking tests are described briefly. Available from Supt. of Documents, U. S. Gov't Printing Office, Washington 25, D. C., at 10 cents each.

• • •

Chemistry of Natural Food Flavors reports a symposium sponsored by the National Academy of Sciences, National Research Council for the Quartermaster Food & Container Institute for the Armed Forces. Methods used in flavor research are described and discussed. Flavor characteristics of several important classes of foods are given special attention. Included in these is a section on bread flavor by Lazare Wiseblatt of the American Institute of Baking. Copies are available upon request to the Quartermaster Food & Container Institute for the Armed Forces, 1819 W. Pershing Road, Chicago 9, Ill.

• • •

Amino Acid Content of Foods, by M. L. Orr and B. K. Watt. Home Economics Research Report No. 4, USDA, Dec. 1957. Supt. of Documents; 45 cents.

• • •

Insect Control in Flour Mills, by R. T. Cotton. Agriculture Handbook No. 133, USDA, Feb. 1958. Supt. of Documents; 15 cents.

• • •

Major Statistical Series of the USDA — How They are Constructed and Used; vol. 5, Consumption and Utilization of Agricultural Products. Agriculture Handbook No. 118, Dec. 1957. Supt. of Documents; 50 cents.

• • •

Procedures for the Testing of Intentional Food Additives to Establish Their Safety for Use. World Health Organization Tech. Report Series, No. 144. Available at 30 cents per copy from Columbia Univ. Press, 2960 Broadway, New York 27, N.Y.

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Quantitative Organic Analysis. J. S. FRITZ and G. S. HAMMOND. (303 pp.) John Wiley & Sons, Inc., New York, N. Y., 1957.

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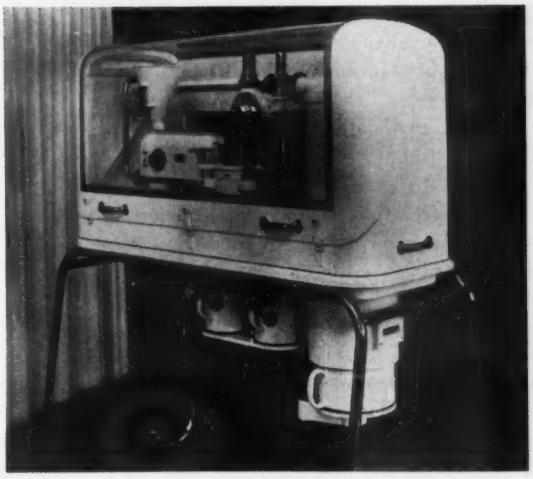

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news of the association

AACC DUES INCREASED

At our recent Annual Meeting in Cincinnati, the members at the business session voted unanimously to increase AACC dues. The business session was unusually well attended, a fact much appreciated by your officers. While the official report was given by the Secretary in the May issue of THIS JOURNAL, I would like to comment on a number of points that were discussed before the vote.

I believe the most significant fact that was brought out concerned the value of the goods and services received by each AACC member during 1957. The Treasurer pointed out that the actual cost of providing publications and miscellaneous services amounted to $26.90 per member. In other words, every member received a $26.90 value for only $10.00.

Now, you may wonder how this can be accomplished. The answer is quite simple. The AACC has a number of outside sources of income which are used to supplement the income from membership dues. Among these outside sources are back-issue sales, exhibit sales at annual meetings, special reprints, and publication advertising. The major source is advertising.

Each year, the Association attempts to provide its members with the maximum amount of goods and services that can be distributed with the available outside income. Each year the income varies, but usually it shows a gradual increase. If the income in any given year fails to show an increase, no new projects are undertaken for that year. The situation becomes more complicated when expenses rise faster than income, as during an inflationary period. The Association has been experiencing such a period for the past couple of years and, thus, has had to rely quite heavily upon its reserves. This must stop if the Association is to remain financially sound. It is for the above reasons that the Board of Directors asked for and received from the membership authority to increase the dues to $15 per year for Active; $20.00 per year for Sustaining; $50.00 per year for Corporate. In addition, the subscription rate of CEREAL CHEMISTRY to nonmembers has been raised from $11.00 to $15.00 per volume.

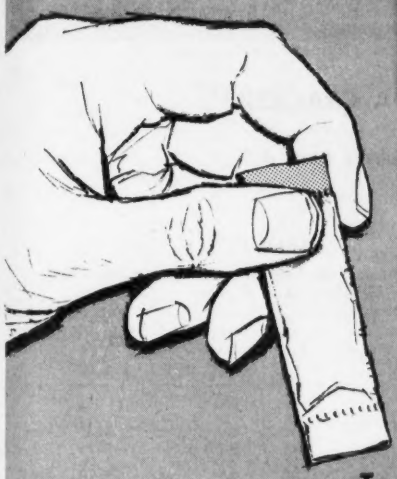
The additional income received from the dues increase will enable us to operate without using our reserves and to carry out programs already requested by our members that we have had to sidetrack for lack of funds. One thing should be made quite clear: *the dues increase will still not cover the actual cost of providing goods and services to the members.* For every $15.00 received in dues, we will *still* be spending a minimum of $27.00 in actual cash. To move ahead, we must increase our supplementary or outside income by a considerable amount.

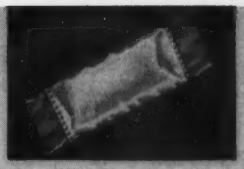
I cannot stress sufficiently the importance of support by the individual member in obtaining an increase in these outside sources of income. Advertisers want to know their message is appearing in a publication that is read. They want an indication of readership or response to their message. This does not necessarily mean just increased sales. Advertisers would like nothing better than to receive inquiries from AACC members asking for further information or some product mentioned in an advertising message. Technical sales people would like to be told while making a call that such and such an ad was noticed and read.

These seemingly minor responses on the part of our members mean the difference between a supplier's using AACC publications to advertise in or turning to some other medium. Financially successful publications in the scientific field have reached that goal only through the loyal support of members of their organizations. Such success means more editorial material to the member at less cost. So I strongly urge every member to give us a hand during this critical period and push AACC publications among your suppliers. If your suppliers now advertise, please let them know you are aware of it and that the Association appreciates it. If they don't advertise, let them know you notice it, and point out to them the advantages of using a society publication to put across their sales message. With support from all of our members, we will have our financial problems licked and be equipped to provide more services that will benefit you in your job and in your profession.

A second area where all members can contribute to the growth of the AACC is in recruitment of new members. Whenever a potential member starts work for your company, talk to him about the activities of the organization and invite him to attend one of the local section meetings. After he has met a number of the local members and has seen our publications, offer to sponsor his application for national membership. A little missionary work on your part for the AACC will pay dividends in the future.

CLINTON L. BROOKE





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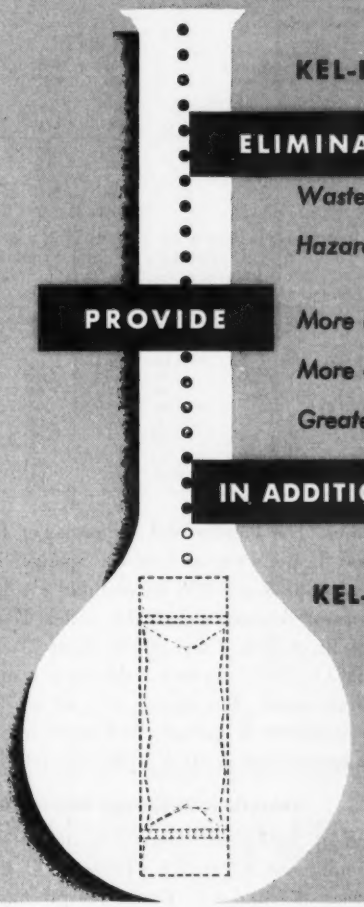

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THE EFFECT OF FLOUR AGING ON THE QUALITY OF SODA CRACKERS[1]

JAN MICKA, Research Department, United Biscuit Company of America, Melrose Park, Ill.

THE EFFECT OF flour aging on the quality of soda crackers is a highly controversial subject. There are nearly as many different views on this subject as there are soda-cracker "experts." Some bakery operators insist on aging flours on a monthly, weekly, or even daily basis. It is well known that cracker flours may be several months old when baked or baked immediately after milling, and in either case produce good crackers. Some recent views on flour aging were expressed by Cosgrove (2), who described the absorption of oxygen from air by flour batters as being due to the action of lipoxidase and stated that the rate of uptake is affected by flour aging. Geoffroy (3) associated baking quality improvement during flour aging with increase in fatty acid. The multiple enzymatic nature of wheat flour was discussed recently by Pence *et al.* (6).

Materials and Methods

Collaborative studies on cracker flours were carried out in six laboratories and three commercial bakeries to determine the effect of flour age on the quality of soda crackers. Tests were run weekly (daily in one bakery) over a 3-month period (except the first week when the flours were shipped), in the fall of 1955 and again in 1956. Commercial unbleached flours, milled from 1955 and 1956 wheat crops of various types from various locations and packed in paper bags, were used in these tests. The results of chemical and bacteriological analyses (1) of the flours are reported in Tables I and II. Farinograph tests (1) of the flours were run in two of the six collaborating laboratories. Two other laboratories carried out cookie-baking tests (1). Bread-baking tests with soda-cracker formula (4) were made by four of the laboratories. The results of all these tests showed small but insignificant changes over the 3-month storage period. The only consistent change in the flours detected by laboratory analyses was a gradual decrease in moisture to as low as 8.3%. Differences due to flour age were not detected in the commercial baking tests which were carried out once a week. However, in the commercial tests performed daily for a period of 3 months, there was a definite variation in soda-cracker quality with flour age. This variation was closely related to changes in microflora, as was shown later. Because the results of the tests on the 1955 and 1956 wheat crops were similar, only the 1956 data are reported. All of the flours used in the collaborative studies are listed in Table I. Only three of these flours (2, 3, and 5) were used for the daily baking studies. The commercial soda-cracker formula based on 1,000 lb. flour was as follows: Sponge — 60% flour (400 lb. of flour 5 and 200 lb. of flour 3), 12.0% lard, 0.3% compressed yeast, and 29.0% water. Dough — 40% flour (200 lb. of flour 3 and 200 lb. flour 2), 1.25% salt, 0.6% $NaHCO_3$, 1.5% diastatic malt extract, and 1.0% dextrose hydrate sugar. The sponge was set at 70°F. and pH 6.0. Fermentation of sponge (21 hours) and dough (4 hours) was carried out at 80°F. and 75% relative humidity.

TABLE I

ORIGIN OF WHEAT AND CHEMICAL ANALYSES OF 1956 WHEAT CROP FLOURS

Origin and Kind of Wheat	Flour	Ash[a]	Protein[a]	Apparent Viscosity		pH
				0 Time	1 Hour	
		%	%			
Michigan White soft winter	1	0.37	8.0	38	64	6.0
	2	0.36	8.2	45	68	6.0
Indiana Red soft winter	3	0.39	8.6	56	70	5.9
	4	0.40	8.9	58	74	6.0
	5	0.39	9.2	72	91	6.0
Missouri Red soft winter	6	0.42	9.4	74	87	5.9
Blend of Illinois red soft and red hard winter and Kansas red hard winter	7	0.42	9.6	68	82	6.0
Pacific coast spring white and red blend	8	0.40	8.7	54	66	5.9

[a] 14% Moisture basis.

TABLE II

BACTERIA PER GRAM ON FLOURS 2, 3, AND 5 DURING THE 3 MONTHS OF FLOUR STORAGE

Number of Weeks	Flour 2	Flour 3	Flour 5
2	3,100	7,800	1,700
3	2,400	5,600	1,400
4	1,200	3,500	800
5	1,500	2,300	1,200
6	2,300	3,800	1,000
7	1,900	4,300	700
8	2,000	3,400	1,100
9	2,000	3,100	900
10	1,600	3,000	600
11	1,200	2,400	800
12	2,400	2,400	900
13	1,700	2,100	700

Variations in Sponge Due to Flour Age

pH of Sponge at Remix. The pH range of the sponges at remix was 3.8 to 5.5 (Table III); the majority were between 4.4 and 4.8. There was no significance between variations in pH and variations in cracker quality.

Temperature Rise and Gas Production at Sponge Remix. During the second and most of the third week of flour storage, temperature rise and gas production of the sponges at remix (100% assigned to normal gas production in Table III) were above normal, followed by a slight decline in the latter part of the fourth and early part of the fifth week (Table III). By the end of the fifth

[1] Manuscript received March 12, 1958. Chairman's report, Cracker Flour Committee. Presented at the 42nd annual meeting, San Francisco, Calif., May 1957.

TABLE III

VARIATIONS DUE TO FLOUR AGE IN pH, TEMPERATURE RISE, GAS PRODUCTION, AND YEAST AND BACTERIAL COUNTS IN 21-HOUR CRACKER SPONGES AT REMIX

WEEK AND DAY[a]	pH	TEMPERATURE RISE	GAS PRODUCTION[b]	YEAST PER GRAM	TOTAL BACTERIA PER GRAM	ACID PRODUCERS PER GRAM
		°F	%	*thousands*	*thousands*	*thousands*
II—1	4.9	16	112	52.9	43.6	8.1
2	4.7	18	114	55.2	44.3	9.5
3	4.4	17	117	56.3	45.5	9.8
4	4.8	19	115	53.8	42.9	9.3
5	4.5	16	114	51.6	42.4	9.8
III—1	5.5	15	109	46.7	38.7	8.6
2	4.8	16	111	51.9	43.5	9.2
3	4.6	18	110	53.5	42.4	9.8
4	4.4	14	107	52.5	41.7	9.3
5	4.2	15	104	53.8	42.4	9.3
IV—1	4.8	11	97	42.7	35.6	8.1
2	4.5	13	100	43.4	36.8	8.4
3	4.6	12	96	42.8	34.6	8.3
4	4.9	9	92	39.7	28.6	7.4
5	5.2	8	88	38.3	27.3	7.6
V—1	5.4	8	91	36.4	26.8	7.1
2	5.1	10	93	37.0	27.8	7.3
3	4.9	11	95	38.5	29.0	7.8
4	4.7	11	97	40.5	31.1	8.2
5	4.5	12	98	41.8	31.8	8.8
VI—1	4.9	11	97	39.7	30.7	8.3
2	4.7	12	99	42.8	33.5	9.1
3	4.4	12	100	43.2	34.2	9.4
4	4.3	14	102	43.7	33.3	9.1
5	4.4	13	101	44.6	33.0	9.5
VII—1	4.6	12	98	41.4	32.6	8.9
2	4.4	13	101	45.3	33.5	9.3
3	4.4	11	100	46.1	34.8	10.1
4	4.3	12	101	47.6	35.4	10.5
5	4.1	14	102	48.3	34.5	10.3
VIII—1	4.2	11	100	42.6	31.5	9.7
2	3.9	13	101	43.2	32.3	10.2
3	3.8	11	101	41.6	30.9	11.7
4	4.0	11	99	44.5	33.6	10.5
5	4.2	12	98	45.3	32.1	10.8
IX—1	4.4	12	99	43.6	30.7	10.5
2	4.6	13	102	46.3	32.7	10.5
3	4.6	12	100	47.3	33.2	11.6
4	4.7	14	100	45.3	33.0	11.3
5	4.5	13	101	44.4	32.6	11.1
X—1	4.6	11	98	42.4	29.9	10.8
2	4.5	13	99	45.5	31.4	11.7
3	4.5	12	101	44.3	30.3	12.2
4	4.4	13	101	43.7	31.7	11.6
5	4.4	12	102	44.5	32.1	12.0
XI—1	4.4	13	101	43.8	30.5	11.6
2	4.6	12	100	45.1	31.6	12.2
3	4.7	14	103	42.7	31.1	12.7
4	4.5	11	103	41.8	32.5	11.8
5	4.3	12	102	40.9	29.3	11.1
XII—1	4.6	11	98	41.8	28.9	10.3
2	4.6	12	103	42.8	30.6	10.8
3	4.4	14	102	43.2	31.3	11.6
4	4.3	14	100	42.5	31.6	11.9
5	4.2	13	100	44.7	30.3	11.3
XIII—1	4.4	12	100	39.6	27.6	10.6
2	4.5	11	103	38.5	29.4	11.1
3	4.3	13	102	40.5	28.4	11.3
4	4.2	14	101	41.4	30.2	12.7
5	4.3	12	100	40.7	29.1	12.3

[a] For weeks: Roman numerals II, etc.; days: Arabic 1, etc.
[b] A score of 100% is given to a sponge with normal gas production.

week and until the end of the storage period, temperature rise and gas production were normal.

Yeast and Bacterial Populations at Sponge Remix. The method used for bacteriological tests was described by Micka (5). The yeast is believed to have a predominating influence on sponge fermentation (5). Yeast counts were higher than bacterial counts at all times (Table III), even during the second and third week of flour storage when gas production of the sponges was excessive. The yeast and bacterial counts are interrelated, affecting each other during the sponge fermentation and thus the quality of the finished product (5). Variations in yeast and bacterial counts were very pronounced in the second and third week of flour storage. However, counts of yeasts and acid-producing bacteria declined in the latter part of the fourth and early part of the fifth week, and this decline was reflected in lower quality of the finished product. It was concluded that this is a critical period of flour storage, during which baking should be avoided. Yeast and bacterial counts became normal after the fifth week of flour storage. At this time (sixth week) and up to the end of the storage period, the flours were regarded as being in a stable condition. Although there were variations in counts of yeasts and of bacteria (total and acid-producing), they were less pronounced and showed a slight gradual decline. The decline in bacterial counts was also noticeable in the flours (Table II) during storage.

Variations in the Baked Cracker Due to Flour Age

pH of the Baked Cracker. From the second through the fifth week of flour storage, the crackers produced from the stored flours showed considerable variations in pH, ranging from 6.2 to 8.3 (Table IV). There was less variation in the pH of the crackers baked from flours aged longer than 5 weeks.

Cracker Moisture. The moisture of the crackers baked from the flours stored from 2 to 5 weeks was higher (3.9 to 5.6%) than that of the crackers baked from flours stored longer than 5 weeks (2.7 to 4.8%).

Volume, Tenderness, and Bloom. A decrease was observed in the volume, tenderness, and bloom of crackers baked from flours stored up to 5 weeks, greatest in the latter part of the fourth and the early part of the fifth week (Table IV). This time the crackers passing through the oven lacked ability to take on the usual brown color in the center while the edges scorched and burned easily. At the end of 5 weeks of storage, the volume, tenderness, and bloom of crackers baked from stored flours showed improvement (Table IV) and remained fairly constant throughout subsequent baking tests. Variations in cracker quality due to flour age were very well correlated with variations in cracker bloom over the entire test period, and consequently it was concluded that bloom is one of the most important factors for evaluating the quality of crackers baked from stored flours.

Discussion of Results

Tuzar[2] reported six endogenous and twelve exogenous variables which can be measured. Additional variables are due to the formula, mixing, machining, and baking and are so numerous that they should be regarded as multiple. Changes during flour storage are complex, and this is only one of many other variables in the processing of crackers. Chemical change due to air oxidation, on the other hand, is only one variable of many complex changes occurring during flour storage. Also, changes of biological origin, in particular those caused by enzymatic action from enzymes native to the flour and from bacterial sources, are believed to be responsible to a large

[2] Tuzar, J. The first principle of thermodynamics as applied to fermentation. Presented at annual meeting of Institute of Food Technologists, St. Louis, Mo., June 1956.

TABLE IV

VARIATIONS DUE TO FLOUR AGE IN pH, MOISTURE, VOLUME, TENDERNESS, AND BLOOM OF CRACKERS

DAY AND WEEK[a]	pH	MOISTURE	RELATIVE VOLUME[b]	TENDERNESS	BLOOM
		%	%		
II—1	8.3	5.8	95	fair	fair
2	7.7	4.8	97	fair	fair+
3	8.1	5.1	96	fair	fair
4	7.6	4.7	97	fair	fair
5	7.8	4.9	96	fair	fair
III—1	7.4	4.8	97	fair	fair
2	6.3	4.3	98	fair+	fair+
3	7.0	4.4	97	fair	fair
4	7.1	4.3	97	fair	fair
5	7.1	3.9	98	fair+	fair+
IV—1	7.3	4.6	96	fair—	fair
2	6.7	4.4	95	fair	fair
3	6.2	5.2	94	fair	fair—
4	7.5	5.3	87	fair—	poor
5	7.8	5.4	85	fair—	poor
V—1	8.0	5.1	84	fair—	poor
2	7.7	4.8	88	fair—	poor
3	6.9	5.0	92	fair	fair—
4	6.6	4.6	96	fair	fair
5	6.5	4.4	96	fair	fair
VI—1	7.6	4.5	98	fair+	fair+
2	7.4	3.8	100	good	good
3	7.2	3.6	101	good	good
4	7.2	4.1	101	good	good
5	7.1	3.4	103	good	good
VII—1	7.4	3.8	101	good	good
2	7.7	4.1	100	good—	good
3	7.0	3.3	104	good	good
4	6.6	3.8	101	good—	good—
5	6.5	4.8	98	good—	good—
VIII—1	7.9	4.7	99	good—	good
2	7.6	3.3	106	good	good
3	7.5	3.4	104	good	good
4	6.9	3.8	103	good	good
5	6.8	4.1	101	good—	good—
IX—1	7.2	3.7	102	good	good
2	7.3	3.4	101	good	good
3	7.2	3.2	105	good	good
4	7.0	2.8	106	good	good
5	7.5	3.1	103	good	good
X—1	7.6	4.7	99	good—	good—
2	7.7	4.5	101	good	good
3	7.8	4.6	100	good—	good
4	7.3	4.5	104	good	good
5	7.2	3.4	103	good	good
XI—1	7.2	3.7	100	good	good
2	6.8	3.2	102	good	good
3	6.5	3.6	106	good	good—
4	6.7	3.3	105	good	good—
5	7.0	3.1	104	good	good
XII—1	7.3	3.2	101	good	good—
2	7.1	2.9	103	good	good
3	7.4	2.7	104	good	good
4	7.6	3.0	102	good	good
5	7.4	2.8	103	good	good
XIII—1	7.0	3.4	98	good—	good
2	7.2	2.8	101	good	good
3	7.4	2.7	105	good	good
4	7.6	2.9	104	good	good
5	7.4	3.1	104	good	good

[a] For weeks: Roman numerals II, etc.; days: Arabic 1, etc.
[b] Relative volume of 1-lb. carton of crackers is expressed as 100%.

extent for desirable and undesirable effects due to flour aging. In processing of crackers some variables are favorable and some are not. Unfavorable variables have their predominating effect, not immediately after the milling process but in the latter part of the fourth and the early part of the fifth week of flour storage. After the fifth week the favorable variables predominate, which again results in increased tolerance in processing. Although "the standards" are highly desirable in cracker processing because of the multiple variables, for a top-quality product adjustments are necessary in mixing, fermentation, and especially in machining and baking, requiring expert and experienced operators. For that reason "the standards" are indicative rather than to be followed rigorously.

Summary

This collaborative study has shown that laboratory tests for cracker flours were only of limited value because the commercial processing of soda crackers involves many other variables which cannot be duplicated by laboratory technique and require constant supervision and adjustment by expert operators. In processing, changes brought about by biological action of multiple enzyme systems (from flour bacteria and yeast) during mixing, fermentation, and initial phase of baking exert a predominant influence on the quality and uniformity of the finished product. Bloom (browning effect) of soda crackers was found to be the most important factor for evaluating the quality of the finished product.

Acknowledgments

The Chairman wishes to express his appreciation to the following Cracker Flour Committee members and collaborators: A. E. Benson, R. R. Gartner, W. H. Hanson, W. L. Heald, T. E. Hollingshead, J. S. Kelley, M. Lawrenson, Ray Mooi, Millo Prochazka, W. V. Sprenger, L. S. Thomson, and A. G. O. Whiteside.

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NUTRITIONAL "PLUS VALUES" FOR CEREAL PRODUCTS

C. L. WRENSHALL and C. FELDBERG, Technical Service Department, Chas. Pfizer & Co., Inc., Brooklyn, New York

WITH MODERN SCIENTIFIC advances in combating infectious disease and in utilizing antibiotics and synthetic chemotherapeutic drugs, the so-called degenerative diseases are demanding more attention. The belief is gaining even wider acceptance that optimal nutrition is of fundamental importance — not only to prevent diseases obviously caused by nutritional deficiency, such as scurvy, beri-beri, and pellagra, but also in maintaining general health and warding off chronic diseases. As a result of these advances a greater proportion of our population is reaching old age, and optimum nutrition is especially important for older people who, perhaps because of poor appetite and faulty dentition, tend to eat less of high-quality foods.

In addition, the average diet in the United States, with its abundance and variety of "convenience" foods, consists of as much as 50% "empty calories." This becomes obvious when we consider that something like 40% of our calories are obtained from refined fats and 10% from refined carbohydrates. Those foods which contribute the remaining half of our calories must, therefore, bear twice the burden of supplying the essential nutrients. Here is good reason for fortifying this remaining half of our foods with amino acids and vitamins.

This "empty calories" theory does not apply to cereal foods, especially bread, since they already have a number of built-in "plus values" — although they are deficient in other respects. Cereal foods are generally considered to be economical sources of calories, protein, and some vitamins and minerals. Cereal foods are also unique in that they are marketed in calorie-controlled portions. As Fig. 1 shows, 5 cents' worth of enriched bread contributes one-fifth of the daily allowance of thiamine for adult

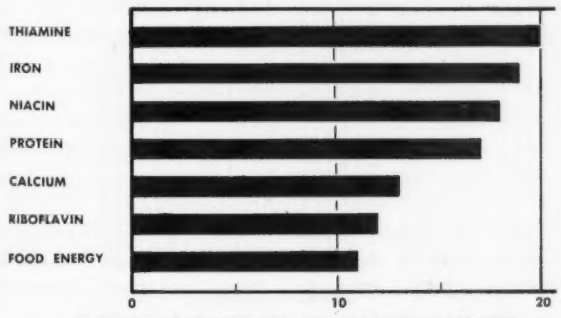


Fig. 1. Nutritional contribution of five cents' worth of bread. Enriched bread, approximately 6 slices ½-in. thick weighing 23 g. each. Based on the 1954 Bureau of Labor Statistics average price for the United States, 17.2 cents per pound loaf. (See reference 37.)

males as recommended by the U. S. National Research Council. Similarly, this amount of bread supplies significant levels of other essential nutrients.

We must now consider what the "minus values" are, as this term may be applied to cereal products. In most cereals the protein quality is inferior to that of high-quality animal protein foods. Bread and most cereals are lacking or deficient in certain nutrients, especially vitamins B_6 and B_{12}. This paper proposes to discuss means of turning these "minus values" into "plus values."

Amino Acid Supplements

Dietary proteins constitute man's principal source of nitrogen. The proteins in foods from plant and animal sources, however, differ both qualitatively and quantitatively in amino acid composition. The proteins of meat, eggs, fish, and milk have high nutritional value because they contain a good balance of the essential amino acids, resembling that required by body tissues. Cereal proteins, on the other hand, such as those in wheat flour, rice, and corn meal do not contain the correct proportions of essential amino acids, being most deficient in lysine. In comparison with whole-egg protein, wheat-flour protein is deficient in lysine (Fig. 2).

The addition of nonfat dry milk serves to improve the level of lysine in wheat protein. However, this addition does not yield maximum protein quality (Fig. 3). Attempts to add more than 6% nonfat dry milk to bread have proved unsuccessful because the taste or texture of the bread is adversely affected by such additions.

Figure 3 also shows that, theoretically, the lysine content of wheat-flour protein needs to be approximately doubled in order to make its amino acid balance comparable to that of efficient, high-quality egg protein. This hypothesis has been confirmed by various investigators (13,14,15,25). For example, Rosenberg and co-workers (25) have shown by rat growth studies that 0.2% *L*-lysine added to commercial white bread, containing 3% nonfat dry milk and 2% yeast, improved protein efficiency 70 to 100% (Fig. 4). In this case, the optimum economic level can be realized by an addition of 0.2% *L*-lysine. True, there must be some reservation in applying rat work to human needs, but many of today's accepted allowances for essential nutrients were derived from studies in genetically selected rat colonies.

In addition, both Hegsted *et al.* (11) and Mitchell (20) in separate publications have reported that the metabolic utilization of food proteins by man closely resembles that of the growing rat. In a more recent paper, Hegsted (10) pointed out that there are only relatively minor variations in the amino acid requirements of man and animals, and the biologic value of food proteins obtained with the rat is believed to be essentially applicable to man.

In a practical application of this concept the Food and Drug Directorate of the Canadian Department of National Health and Welfare has proposed criteria (7) for describing the protein value of food products to be sold. These criteria are based on a method of evaluation which

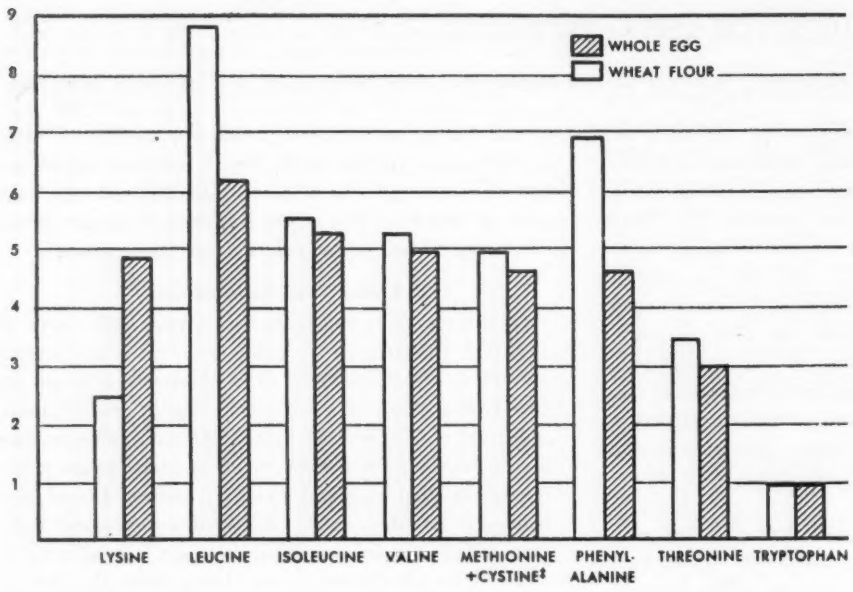


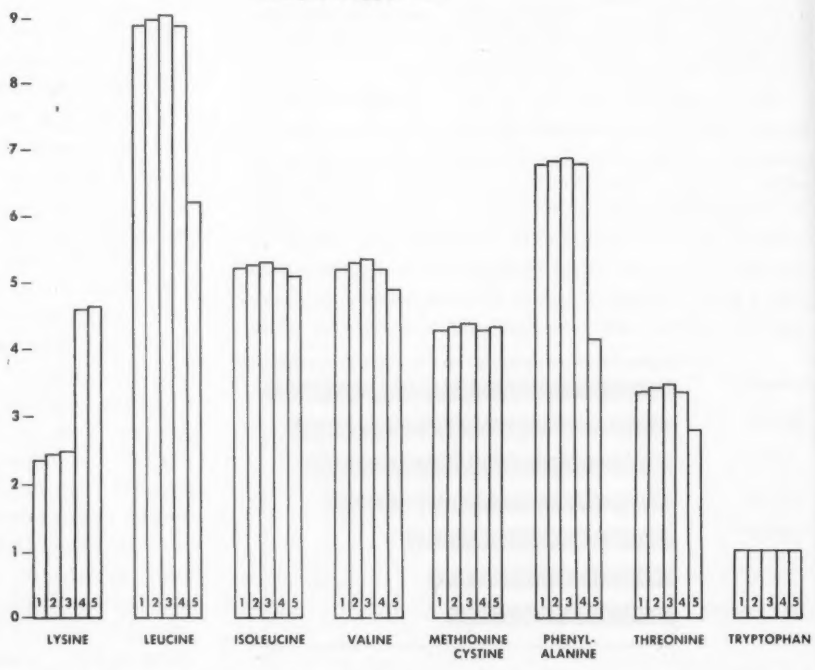
Fig. 2. Amino acid proportions, based on tryptophan as unity, in wheat flour protein and in whole egg protein (based on data from Block and Bolling, ref. 5). Part of the requirement for methionine can be supplied by cystine.

utilizes weanling male rats as the test animal. The food to be tested is fed at a level of 10% protein in an otherwise complete diet. It is realized by these authorities that the value so obtained may not be that of the protein as a constituent of a normal diet, but they believe that any claims made should apply to the individual food product.

A recent study by Albanese and co-workers (1) points up the special usefulness of lysine supplementation in the diets of elderly people. The authors pointed out: ". . . the observations reported here indicate that, under conditions of nutritional stress resulting from disease, poor food habits, or other causes, there may be an associated appetite depression in old age or convalescence which, regardless of economic circumstances or food availability, predisposes the preponderant selection of cereal protein foods, and especially wheat products, which are easy to chew. Fortunately, the amino acid proportions in wheat products, except for lysine, are similar to those found in good-quality animal proteins. Under these circumstances, lysine supplements could be expected to improve the protein nutrition of that segment of the population subsisting on diets relatively poor in good-quality proteins. Our findings indicate that small additions of lysine to the diet of elderly adults under nutritional stress greatly enhance the biologic value of diets, especially those low in meat proteins."

Another area where lysine supplementation can be especially useful is in breakfast cereals. In these foods, which are subjected to high processing temperatures, the loss of natural lysine is quite extensive. Table I shows that in these commercial cereals there is a 34.2 to 58.6% loss of lysine due to processing (6). It is evident from these figures that supplementation of these types of cereals with small amounts of lysine is not only feasible but desirable.

Fig. 3. Amino acid proportions in wheat flour protein, with and without added nonfat dry milk and lysine, and in egg protein. 1—white flour protein; 2, 3, 4, white flour protein with respective additions: 3% nonfat dry milk; 6% nonfat dry milk; 0.25% L-lysine monohydrochloride; 5, egg protein.



This, then, is one important area in which a "minus value" may easily be converted into a "plus value," that is, by improving the protein quality of cereal foods.

Addition of Vitamins

In addition to the shortage of amino acids in wheat protein, bread and other cereals are lacking in certain vitamins such as A, D, C, B_{12}, and B_6. Although none of these vitamins except B_6 are naturally found in cereals,

TABLE I

PROCESSING LOSSES OF *L*-LYSINE IN READY-TO-EAT BREAKFAST CEREALS[a]

CEREAL	RAW CEREAL	PROCESSED CEREAL	LYSINE LOSS
	g lysine/16 g N	*g lysine/16 g N*	%
Corn flakes	1.9	0.9	52.6
Rice flakes	3.8	2.5	34.2
Wheat flakes	2.9	1.2	58.6
Wheat, puffed	2.5	1.1	56.0

[a] Adapted from: Block and Weiss (6).

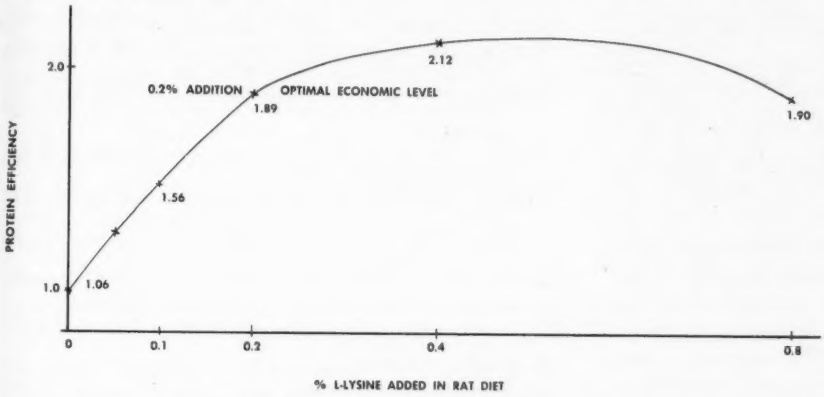


Fig. 4. Improvement in protein efficiency of commercial white bread by addition of L-lysine, as shown by rat-growth studies. (See reference 25.)

there is no reason why they or any other nutrient not found naturally should not be added; some breakfast cereals on the market at present are already supplemented. Moreover, in populations where there is a decided deficiency or even marginal intake of a specific nutrient, it is essential that such nutrients be supplied in foods which are inexpensive or universally eaten; cereal foods satisfy these prerequisites.

That vitamin B_6 is essential in human nutrition is now an established fact. Its biochemical and physiological functions in the body are quite complex. Numerous investigators have shown that the coenzyme form of vitamin B_6, pyridoxal phosphate, is concerned in amino acid metabolism and protein synthesis. It has been shown to play a part in decarboxylation processes by acting as a co-decarboxylase in the decarboxylation of tyrosine, arginine, and glutamic acid (3,27). It is also essential for the proper utilization and metabolism of lysine, methionine, histidine, cystine, glycine, alanine, and tryptophan (2,27,30). In fact, vitamin B_6 is so regularly involved in amino acid reactions that it has been called "the amino acid metabolism vitamin" (4). In light of the previous discussion on protein quality, it is obvious that the B_6 content of cereal foods should be at its optimum level in order to attain the maximum utilization of the protein. This is especially important when bread is fortified with nonfat milk solids and lysine so that full value is obtained from these additives.

Vitamin B_6 is involved in the development of the teeth, especially in growing children. Pyridoxine deficiency renders the teeth particularly vulnerable to decay (24) and, conversely, it has been found that children chewing sugar cane and eating large quantities of molasses, despite poor oral hygiene, showed considerable resistance to dental caries (31,32). This was attributed to the high vitamin-B_6 content of these foods. Vitamin B_6 is not found in refined sugar or candies.

Vitamin B_6 is also intimately connected with the metabolism of essential fatty acids. In fact, it has been suggested that this vitamin is necessary for the conversion of linoleic to arachidonic acid (19,23). Since B_6 is concerned with the formation and utilization of unsaturated fatty acids, an excessive intake of saturated or even monoethenoid fatty acids might overtax the pyridoxal system, resulting in a relative deficiency of unsaturated fatty acids, especially arachidonic. This could be especially true if the coenzyme, pyridoxal phosphate, were present in limited amounts because of an insufficient intake of vitamin B_6 (18,28). If the pyridoxal enzyme system were overtaxed by a high intake of saturated fatty acids or by a limited intake of vitamin B_6, thereby interfering with conversion and utilization of unsaturated fatty acids, this could very possibly lead to the accumulation of less soluble esters of cholesterol in the tissues.

The daily need of the human body for vitamin B_6 has been estimated at 1 to 2 mg. (21,29) and also at 2 to 3 mg. (22,38). Actually, it appears that the diet of many Americans may be marginal or deficient in B_6 (22).

Processing may seriously affect the B_6 content of food (8). Teply and co-workers (36) assayed samples of wheat by the rat growth method and reported the pyridoxine content of the various fractions as follows:

	mg/lb
Wheat germ	4.36
Whole-wheat flour	2.09
Patent flour	0.99

Thus, patent flour contains less than one-half the pyridoxine content of whole wheat flour.

Almost all white breads on the market today are enriched so as to contain 1.1 to 1.8 mg. of thiamine per lb. Since the recommended daily dietary allowance for thiamine is between 1.2 and 2.0 mg., bread has been enriched to supply a substantial portion of the daily need of this essential nutrient. As stated above, research has indicated that the intake of vitamin B_6 should be between 1 and 3 mg. daily. However, a 1-lb. loaf of bread supplies only 0.45 mg. of this B vitamin. It therefore appears logical to raise the vitamin-B_6 content of bread to at least that of thiamine. A recent publication by Page (22) has already recommended that bread manufacturers take the lead in relieving the marginal intake of B_6 in the American diet. It should be noted here that the nonfat dry milk used in making bread does not raise the vitamin-B_6 content of bread to any appreciable degree.

As mentioned previously, cereals are lacking or deficient in vitamin B_{12}. Although a minimum daily requirement has not been established for B_{12}, this vitamin is recognized as an essential constituent of human nutrition. Man depends on an adequate daily intake of foods containing vitamin B_{12} to satisfy body requirements. As the table below indicates, the liver and kidney are rich sources of B_{12}, while cereal products are poor sources (12,39).

Vitamin B_{12} Content of Foods

	γ/100 g
Beef liver	31–120
Beef kidney	18–55
Nonfat dry milk	2.5–4.0
White flour	negligible
Whole-wheat flour	negligible

Vitamin B_{12} is required for normal blood formation, growth, neural function, nutritional maintenance, and those fundamental processes involved in the metabolism of fats, carbohydrates, and proteins (9,16,17,26). Wild and co-workers (39) have demonstrated that vitamin B_{12} stimulates intestinal resorption and utilization of amino acids, thus indicating a stimulation of protein synthesis.

In various studies, Sure (33,34,35) has shown that cereal proteins fortified with lysine could be further improved by additions of threonine, valine, methionine, and vitamin B_{12}.

As with vitamin B_6, the vitamin-B_{12} content of cereal foods should be at its optimum level in order that the protein in these products can be utilized to the maximum extent. This is especially important when bread is fortified with nonfat dry milk and lysine.

Summary

The "minus values" of cereal products can be turned into "plus values" by supplements of amino acids and vitamins. The amino acid most deficient in cereal proteins is lysine, and moreover there is extensive loss of lysine during processing. Bread and other cereals are lacking in certain vitamins, such as A, D, C, B_{12}, and B_6. The American diet appears marginal or deficient in vitamin B_6, and vitamin B_{12} is an essential constituent of human nutrition. Where there is a deficiency or marginal intake of specific nutrients, it is essential that they be supplied in the diet in foods which are inexpensive and universally eaten. Cereal foods, when fortified with amino acids and vitamins, can meet these needs.

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TEST BAKING METHOD FOR SWEET DOUGHS AND SWEET DOUGH MIXES[1]

DAVID E. DOWNS, Chairman, Subcommittee on Yeast-Raised Products, Prepared Mix Committee

AT THE 1955 ANNUAL MEETING of the AACC, the need was expressed for a standard method of testing sweet dough products. It was pointed out in the Prepared Mix Committee that the suppliers of ingredients, the makers of the mixes, and the users of the mixes had no common ground on which to express their evaluation of the performance of raw materials or of the finished mixes. A subcommittee of the Prepared Mix Committee was formed and charged with seeking a solution to this problem. The group was designated as the Subcommittee on Yeast-Raised Products.

The first project of the committee was to invite all interested members to submit the procedures they used in their own laboratories to evaluate the performance of sweet doughs or ingredients used in their production. The methods submitted showed many points of similarity. After correspondence it was agreed to combine the methods editorially and submit the proposed "Baking Test for Sweet Yeast Products" to collaborative study.

Use of the test with slight modifications from the original proposal has shown that it will serve the purpose of evaluating the performance of sweet dough products. As with any baking test, there must be agreement on the interpretation of those factors which are scored subjectively.

In the preliminary tests the use of AACC pup loaf pans was one option tried. The results of the first series of tests showed that a leaner formula produced a grain and texture more like that of bread, particularly when baked in the pup loaf pans. Those collaborators who were more used to scoring bread or bread flour test bakes tended to rate such grain and texture higher than the more typical coffee cake texture. There was also a difference in specific volume when a series baked in loaf pans was compared to the same series baked in round layer cake pans. For this reason the committee decided that one pan should be adopted as standard and that the round pan was more typical for the product being tested than was a loaf pan.

At the 1958 annual meeting at Cincinnati the subcommittee made a final report to the meeting of the Prepared Mix Committee, with the recommendation that the report be submitted to the Technical Policy Committee as a Tentative Method of the AACC, to become an official method at a later time if experience of the membership should indicate such action to be desirable.

Baking Test for Sweet Yeast Products (Tentative, 1958)

Equipment and Apparatus. 1. Mixer: Hobart, with McDuffee bowl, or equivalent.

2. Thermometers: For dough, AACC thermometers graduated from 15° to 40°C. (59° to 104°F.). (Cereal Chem. 7: 362; 1930.)

3. Fermentation cabinet: Ferment and proof in cabinet capable of maintaining a temperature of 86° ± 1°F., and a relative humidity of at least 75%.

4. Baking pans: Layer cake pans, 8 by 1½ inch (as Wearever No. 5345).

5. Baking oven: Suitable test baking oven operating at 375° ± 5°F.

6. Volume measuring apparatus: Apparatus for measuring volume of baked products by rapeseed displacement.

NOTE. If alternate equipment is used, exact equipment used is to be specified on report of test. Refer to other Baking Test Methods in *Cereal Laboratory Methods*, Section 11.[2]

Formula for Testing Prepared Mixes.

	g.	
Mix	1000	
Water	450	(variable)
Yeast (compressed)	60	

NOTE. If ingredients are being tested, give entire formula used on report of test, pointing out variable ingredients or quantities.

Procedure. 1. Mixing: Mix to complete development of dough (5 to 7 minutes will probably be required with McDuffee equipment). Specify conditions used if other. Dough temperature should be 80° out of mixer.

2. Fermentation: Ferment dough in cabinet at 86°F., 75% r.h. Ferment for 1 hour or to one full rise of dough. Then punch dough, scale into desired pieces, and allow 15 minutes' rest time to make up. Scale 375 g. of dough for 8-in. pan recommended.

3. Molding: Sheet the dough through sheeting rolls of National equipment or by hand. Fold in thirds each direction and flatten so final dough piece is approximately circular and will fit loosely in the baking pan. A plain, flat, circular coffee cake is desired for scoring.

4. Proofing: Proof in same dough cabinet until top of dough is ⅜ in. above sides of baking pan. (Note time required for proofing to this height.)

5. Bake for 20 to 22 minutes at 375°F.

Evaluation of Baked Product. 1. Cool coffee cake 1 hour: then determine volume by rapeseed displacement.

2. Store with normal protection from excessive drying and score following day. A suggested score sheet follows:

Score Sheet for Yeast-Raised Sweet Doughs

I. Volume: Report either volume in cc. of (375-g.) coffee cake, or specific volume (cc. per 100 g. scaling weight).

II. Numerical score:

	Points
Softness	0–25
Color of crust	0–10
Grain	0–10
Texture	0–20
Color of crumb	0–10
Eating quality	0–25

NOTES: Softness: Determine by Baker Compressimeter, Precision Penetrometer, or other suitable method. (Specify method used.)

Color of crust: Describe and evaluate.

Grain: Describe and evaluate.

Texture: Describe and evaluate.

Color of crumb: Describe and evaluate.

Eating quality: Describe. (Tender, tough, moist, gummy, dry, etc.)

An acceptable product should have a numerical score of 70 or above.

Acknowledgment

The assistance of the following members of the Association, who collaborated in this project, is greatly appreciated: James S. Barry, A. F. Borer, George C. Carlin, John C. Fowler, H. H. Favor, R. P. Hopper, and Frank R. Schwain.

[1] Manuscript received July 21, 1958.

[2] Sixth edition; published by the American Association of Cereal Chemists, St. Paul, Minnesota, 1957.

People, Products, Patter

• • • People

Frank L. Aldrich, Jr., now research biochemist at Takamine Laboratory, Clifton, N.J., after completing postdoctoral work in biochemistry at Purdue.

C. H. Bailey will go to Detmold and Bad Meinberg, Germany, to participate as a guest of the Bundesforschungsanstalt fur Getreideverarbeitung in its 50th anniversary celebration Oct. 8–10. He will speak at the jubilee banquet the evening of the 8th and read a paper before the convention. Following the meetings he plans to visit various German cereal schools, research institutes, and industries.

Franklin N. Bent, acid superintendent at Hercules Powder's Parlin, N.J., plant, named assistant manager at the Huron milling division plant, Harbor Beach, Mich.

William Breidster (B.S. in chemistry, Cornell, 1957) joins products research department, foods division, Procter & Gamble.

Elmer B. Brown died at his home in Webster Groves, Missouri, on July 2, a few days after his 66th birthday. He was stricken with a heart ailment while in Paris after enjoying a 3-month tour of Europe with Mrs. Brown, but was able to sail home for rest and treatment.

Mr. Brown was with Anheuser-Busch for some years, until retirement. For the last few years he has operated a consulting laboratory for bakers in his home.

Jerry W. Harlan becomes research chemist with Swift & Co., Chicago.

J. H. Hulse installed as president, Canadian Institute of Food Technology; he is head of food research for the Defense Research Board of Canada and was formerly senior liaison officer with the British Baking Industries Research Association.

Paul L. Kohnstamm, president of H. Kohnstamm & Co., Inc., elected to Young Presidents' Organization, metropolitan New York chapter. YPO conducts seminars at university business schools and holds an annual "School for Presidents."

Roger A. Morrison appointed manager of Lawrenceburg (Ind.) feed sales division of Quaker Oats Co.; has been manager of feed sales training for the company.

Ben H. Redman of Montana Flour Mills Co. has retired after 37 years with the company. He is being replaced in Great Falls by **Samuel Bell** from the Bozeman operation. **John C. Acord** will assume the duties at Bozeman.

Joseph V. Reger appointed sales manager for Foremost Lactose (Western Condensing Co.) on a national basis; has been with the company in research department since 1950; promoted to assistant sales manager, Food Products Division, in 1955. Under Mr. Reger's direction, lactose has for the first time been researched and incorporated in leading consumer products.

Thomas H. Smouse joins National Biscuit research center, Fair Lawn, N.J., as analytical chemist.

William H. Tonkin retires after 35 years with Standard Brands, Inc.; has been technical director of frozen products division in Kansas City, Mo.

• • • Patter

Grain Research Lab report. A copy of the 1957 report of the Grain Research Laboratory, Board of Grain Commissioners for Canada, Winnipeg, Manitoba, has been received. As usual, this report presents a comprehensive account of the work of the laboratory.

Part I describes research studies, both major and minor, in progress in the laboratory, with subsections for Hard Red Spring Wheat, Amber Durum Wheat and Barley, and a final subsection for miscellaneous studies. The descriptions are brief, but, for those who are familiar with the scientific papers published by the laboratory, these accounts serve to indicate lines along which research is being pursued.

Part II deals with variety and quality studies, and again provides subsections for different crops. The variety studies are run each year in systematic cooperation with the Canada Department of Agriculture. Quality studies deal with problems relating to current crops and appear to deal with minor investigations that are not classified as research.

The final section of the report, Part III, deals with the extensive studies made by the laboratory in monitoring the quality of Canadian crops as they move forward from country to terminal elevators and thence to overseas markets. This section is supported by a long appendix, containing tabulated data and maps.

A list of the laboratory's staff is given at the front of the report, liaison activities are listed in Appendix 2, and publications of the laboratory are listed in Appendix 3.

The Grain Research Laboratory (190 Grain Exchange Building, Winnipeg) will be glad to send a copy to anyone who requests it.

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Advertising appointment. All Fleischmann products for bakeries and institutions will be advertised under the direction of Marketing and Advertising Associates, Philadelphia, according to a recent announcement by Standard Brands, Inc.

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One 12-unit digestion and distillation, electric with blower. Combination unit Kjeldahl nitrogen apparatus. Manufactured by Laboratory Construction Company, Kansas City, Missouri.
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T. L. Welsh, President
The Security Milling Co., Inc.
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AACC
LOCAL SECTIONS

Pacific Northwest Section's list of committee chairmen for 1958–59 reflects, as usual, an enthusiastic and actively working group. They are: membership, Jack Miller; special awards, Dick Fuhr; commercial scale milling and baking, Martin Wise; crop survey, C. T. Wheat; PNW grain storage sanitation, E. P. Walker; representative to Agronomy Advisory Board, Don Colpitts; PNW Crop Improvement Association, Joe DeHaan and William L. Haley; representative to Western Wheat Quality Laboratory, Don Sundberg.

• • •

Pioneer Section held its quarterly meeting at the Lassen Hotel, Wichita, on August 1 and 2. Color slides taken at the Cincinnati meetings were shown Friday evening. On Saturday, John Giertz, for the Wheat Crop Reporting Committee, gave data covering Oklahoma, Kansas, Texas, and Colorado. Jeff Schlesinger, member of the National Board of Directors, reported on the national convention in Cincinnati and outlined some of the AACC's plans. C. W. Pence reported on activities of the Kansas Wheat Improvement Association; particularly, efforts to persuade growers to produce more of the good varieties, Comanche and Ponca. George Schiller explained the turbo milling process, with slides.

• • •

New York Section advanced its first meeting of the season to September 9 because of the opportunity of hearing from an authority in the field of amylases, R. H. Hopkins of Birmingham University, Birmingham, England. This was a dinner meeting held jointly with the New York Section of the American Society of Brewing Chemists.

• • •

Tri-Section's meeting scheduled for Friday and Saturday, October 10 and 11 at the Wareham Hotel, Manhattan, will have as opening speakers and subjects: J. A. Shellenberger – Plans for new milling facilities at Kansas State College; R. B. Laing – Activities of the Millers' Advisory Council to Kansas State College; and Raymond Vickery (head of Grain and Feed Division, Foreign Agricultural Service, USDA) – The world wheat situation. Research reports by members of the Department of Flour and Feed Milling Industries, Kansas State College, will follow: Phosphoric acid in formula feeds – Walden Hastings; Enzymatic activity related to storage deterioration – Pekka Linko; Constituents of bread flavor – R. J. Robinson; and Factors affecting enzyme production in malted wheat – James Fleming. At noon luncheon on Saturday, AACC President Clinton L. Brooke will bring members up to date on Association affairs. Ladies will enjoy a 10:00 a.m. Saturday brunch at the Shellenberger home.

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Niagara Frontier Section meets Saturday, Sept. 27, at Birdseye Foods Division of General Foods, Inc., Albion, N.Y., for a conducted tour of the research laboratories and the Horticultural Research Farm.

Section members, individually and collectively, are grateful for monetary contributions toward the cost of this year's outstanding summer picnic, from Feedstuff Laboratories, Fisher Scientific, Hoffman-LaRoche, McAllister-Bicknell, Merck & Co., Sterwin Chemicals, Wallace & Tiernan, and Will-Buffalo.

October 25 is set for a joint all-day meeting with **Toronto Section** and the Niagara District, Association of Operative Millers. Arrangements for speakers, dinner dance, and floor show are shaping up; more details later.

• • • Australia

(EDITOR'S NOTE: This column in the July 1958 issue carried the citation to Dr. R. A. Bottomley on the presentation of the First Australian Award for Contributions to the Food Industry, Canberra, May 1958. Some time afterward a second copy of the citation arrived in the mail, this time accompanied by Dr. Bottomley's response to the presentation. Because so important a part of a memorable occasion should not be left in obscurity, we are giving the letter of response below, even though it comes two issues after the citation itself.)

TO THE INSTITUTE OF FOOD TECHNOLOGISTS, AUSTRALIAN SECTIONS:

Mr. President, Ladies and Gentlemen:

I am deeply conscious of the honor you have paid me in choosing me as the first recipient of the Australian Sections' Award for scientific contributions to the Food Industry. In accepting it with sincere thanks I am reminded of the debt I owe to my teachers, my colleagues, and indeed to all those whose published works have enabled me to improve my own efforts. Since most of my professional life has been spent in industry I am also indebted to my employers for their liberal attitude towards publication. One thinks too, of the value of Associations such as ours, for the benefits of personal contacts such as we enjoy here cannot be overestimated.

I also wish to pay a tribute to my wife, without whose encouragement and unselfishness it would have been impossible to have achieved this Award. For example, I believe I have published some 20 papers, some in conjunction with valued collaborators, but I cannot remember ever writing one in normal working hours. You will appreciate that the "homework" involved has been quite disruptive of ordinary family social activities!

The Award has for me an enhanced value because of the personal efforts made in its selection by our President, Hugh Govers. He was determined to choose on your behalf an Award not only in keeping with the dignity of the Institute, but also one which the recipient would find both beautiful and useful. I think you will agree that he has succeeded admirably.

This handsome tray is a particularly appropriate award, for one associates trays with food, and with service. It will be a cherished possession and I sincerely hope I may continue to assist in the advancement of Science in the service of the Food Industry.

Again, thank you.

R. A. BOTTOMLEY

AACC

LOCAL SECTION OFFICERS

Northwest Section, No. 1

Chairman: HARRY OBERMEYER, General Mills Research Labs, 2010 E. Hennepin, Minneapolis 13, Minn.
Vice Chairman: ROBERT PICKENPACK, General Mills, Inc., 9200 Wayzata Blvd., Minneapolis, Minn.
Secretary: RAY ANDERSON, 109th Ave. & W. River Road, Box 64, Route 1, Osseo, Minn.
Treasurer: EDWARD LIEBE, Grain Branch, USDA, 116 Federal Office Bldg., Minneapolis, Minn.
Meeting place: Minneapolis, Minn.
Meeting date: Last Friday of each month

Pioneer Section, No. 2

Chairman: CLAUDE NEILL, Board of Trade Laboratory, Box 407, Enid, Okla.
Vice Chairman: WAYNE V. PARKER, 630 S. Lorraine Ave., Wichita 16, Kansas
Secretary-Treasurer: WAYNE F. SAMUELSON, Abilene Flour Mills, Abilene, Kansas
Meeting place: Wichita, Kansas, and Enid, Okla.
Meeting date: Regularly in April, August, and December; Tri-State at Manhattan, Kansas, in October and joint meeting with K. C. Section in February

Kansas City Section, No. 3

Chairman: BOYCE W. DOUGHERTY, 1188 Hilltop, Kansas City, Kansas
Vice Chairman: LESTER FISCHER, c/o Rodney Milling Co., 1550 W. 29th St., Kansas City, Mo.
Secretary-Treasurer: ROBERT T. CRAIG, Bay State Milling Co., Leavenworth, Kansas
Meeting place: Kansas City, Mo.
Meeting date: Second Wednesday of each month

Nebraska Section, No. 4

Chairman: PAUL J. MATTERN, 3018 So. 13th Street, Lincoln 2, Nebr.
Vice Chairman: HOWARD C. BECKER, Nebraska Consolidated Mills, 1521 N. 16th St., Omaha 10, Nebr.
Secretary-Treasurer: REX RUCKSDASHEL, Lexington Mill & Elevator Co., Lexington, Nebraska
Meeting place: Not regular
Meeting date: Third Saturday of each month

Central States Section, No. 5

Chairman: RICHARD C. KOHLER, Merck & Co., Inc., St. Louis, Mo.
Vice Chairman: A. R. HANDLEMAN, Monsanto Chemical Co., Inorganic Research Division, Oliver Street Road at Lindbergh, St. Louis 24, Mo.
Secretary-Treasurer: J. T. WATSON, Anheuser-Busch, 21 Pestalozzi St., St. Louis 18, Mo.
Meeting place: Not regular
Meeting date: Not regular

Niagara Frontier Section, No. 6

Chairman: CLAYTON SCHNEIDER, Henry & Henry, Northland & Bailey Aves., Buffalo, N. Y.
Vice Chairman: JACK MONIER, General Mills, Inc., So. Michigan Ave. & Ganson St., Buffalo 3, N. Y.
Secretary: ROBERT VAN BUREK, Wallace & Tiernan, Inc., Flour Division, 975 Fuhrmann Blvd., Buffalo 5, N. Y.
Treasurer: FRANKLIN WAGNER, Feedstuff Laboratories, P. O. Box 144, Buffalo, N. Y.
Meeting place: Buffalo, New York
Meeting date: Second Monday of each month

Pacific Northwest Section, No. 7

Chairman: B. LYNN SPEAKER, 619 Southeast 6th St., Pendleton, Oregon
Vice Chairman: DOYLE C. UDY, Western Wheat Quality Lab., Agricultural Experiment Station, Pullman, Wash.
Secretary-Treasurer: A. J. SHOGAN, No. 4824 Greenwood Blvd., Spokane, Wash.
Meeting place: Different location each year
Meeting date: June, 1959

Midwest Section, No. 8

Chairman: ROBERT B. KOCH, Quartermaster Food & Container Institute, 1819 West Pershing Road, Chicago 9, Ill.
Vice Chairman: E. I. FEIGON, Kitchen Art Foods, Inc., 2320 N. Damen Ave., Chicago, Ill.
Secretary-Treasurer: TOD STEWART, 1133 W. 35th St., Chicago 9, Ill.
Meeting place: Chicago, Ill.
Meeting date: First Mondays, October through May

New York Section, No. 9

Chairman: OTTO JENSEN, National Biscuit Co., Lab. Dept., 449 W. 14th St., New York, N. Y.
Vice Chairman: ELWOOD C. EDELMANN, 40 Birch Street, Port Washington, N. Y.
Secretary-Treasurer: WM. J. SIMCOX, 910 Stuart Ave., Mamaroneck, N. Y.
Meeting place: New York, N. Y.
Meeting date: Second Tuesday, October through May

Lone Star Section, No. 10

Chairman: A. A. ROLFE, Quaker Oats Co., Sherman, Texas
Vice Chairman: GEO. W. SCHILLER, Pillsbury Mills, Inc., Box 1388, Enid, Okla.
Secretary-Treasurer: E. A. VAUPEL, Food Industries Co., 2203 Butler Ave., Dallas, Texas
Meeting place: Not regular
Meeting date: Spring, summer, and fall

Toronto Section, No. 11

Chairman: C. WEBSTER, 5 Weybridge Court, Toronto 18, Ontario
Vice Chairman: THOMAS P. SNOWDEN, Monarch Creamery Products, Ltd., 45 Howard Park Ave., Toronto, Ontario
Secretary: GEORGE WM. SMILEY, c/o Maple Leaf Milling Co., Ltd., 12 Monarch Road, Toronto, Ontario
Treasurer: HUGH KEEPING, Charles Albert Smith, Ltd., 356 Eastern Ave., Toronto, Ontario
Meeting place: Toronto, Ontario
Meeting date: Third Friday of month: September to April

Cincinnati Section, No. 12

Chairman: CLYDE J. STEELE, Rt. 8, Box 3064, Battle Creek, Mich.
Vice Chairman: LEWIS W. BAKER, 1351 Murrell, Columbus 12, Ohio
Secretary-Treasurer: WM. T. YAMAZAKI, Soft Wheat Quality Laboratory, Ohio Agricultural Experiment Station, Wooster, Ohio
Meeting place: Not regular
Meeting date: No fixed date. Usually meetings are held in September, January, May

Canadian Prairie Section, No. 14

Chairman: W. O. S. MEREDITH, Grain Research Laboratory, 886 Grain Exchange Bldg., Winnipeg 2, Manitoba
Vice Chairman: M. H. FISHER, Grain Research Laboratory, 140 Grain Exchange, Winnipeg 2, Manitoba
Secretary-Treasurer: L. H. RENNIE, Soo Line Flour Mills, Ltd., 7 Higgins Ave., Winnipeg 2, Manitoba
Meeting place: Grain Exchange Bldg., Winnipeg
Meeting date: Third Tuesday of each month, Oct. to April

Northern California Section, No. 15

Chairman: WALTER S. HALE, Western Utilization Res. & Develop. Division, 800 Buchanan St., Albany 10, Calif.
Vice Chairman: WESLEY M. NOBLE, 238-E West 36th Ave., San Mateo, Calif.
Secretary: DANIEL G. MCPHERSON, General Mills, Inc., 116 New Montgomery St., San Francisco, Calif.
Treasurer: WM. J. STEPHENS, 71 Aquavista Way, San Francisco 27, Calif.
Meeting place: Not regular
Meeting date: First or second Wednesday of month, October through June

Southern California Section, No. 16

Chairman: CORA MILLER, Home Economics Dept., UCLA, 405 Hilgard Ave., Los Angeles 24, Calif.
Vice Chairman: JOSEPH H. TOPPS, 1861 East 55th St., Los Angeles, Calif.
Secretary-Treasurer: ROBERT REYNOLDS, 5609 Fallsgrove St., Los Angeles 16, Calif.

Chesapeake Section, No. 17

Chairman: ALVIN J. PINCKNEY, 6009 44th Avenue, Hyattsville, Md.
Vice Chairman: J. E. MCGINNIS, 2730 Loch Haven Rd., Baltimore 18, Md.
Secretary-Treasurer: EDITH A. CHRISTENSEN, Rm. 203 South Lab, Grain Branch, USDA, Agr. Research Center, Beltsville, Md.
Meeting place: Not regular
Meeting date: Third Thursday of Sept., Oct., Nov., Jan., Feb., March, April

STARCH AND STARCH PRODUCTS

Starch hydrolysates defined. Until now, no commonly understood set of definitions specifically identifying commercial types of corn syrups and similar starch hydrolysates has been available, and confusion over terms has occasionally handicapped suppliers and consumers alike. To establish a common terminology, the corn refining industry announces definitions (see below) for food products obtained by the controlled hydrolysis of starch, as developed by technical service personnel of the corn wet-milling industry.

The recent announcement by the Corn Industries Research Foundation continues: starch hydrolysates are used in the production of a broad range of foods, including bakery goods, beer, carbonated beverages, canned and frozen foods, confectionery, ice cream, and preserves. In addition to crude corn sugar and refined sugar (dextrose) which are end products of the hydrolytic conversion process, the hydrolysates include corn syrup, corn syrup solids, malto-dextrin, and corn dextrin (not to be confused with the pyrodextrins resulting from the roasting of dry starch). They are obtained through the conversion or hydrolysis of corn starch, accomplished by heat, pressure, and a catalytic agent.

Corn dextrin, malto-dextrin, and **corn syrup** are defined as products obtained by incomplete hydrolysis of starch; their solids contain the following percentages of reducing sugars, calculated as anhydrous dextrose:

	%
Corn dextrin	1–13
Malto-dextrin	13–28
Corn syrup—at least	28

Commercial types of **corn syrup** are defined as clarified, concentrated aqueous solutions of the product obtained by incomplete hydrolysis of corn starch. Four types and the percentage of reducing sugars in their solids, calculated as anhydrous dextrose, are:

	%
Low-conversion	28–38
Regular-conversion	38–48
Intermediate-conversion	48–58
High-conversion	58–68

Corn syrup solids: the product obtained by drying corn syrup; classified in the same manner as the type of corn syrup from which it is made.

The Corn Industries Research Foundation (1001 Connecticut Ave. N.W., Washington 6, D.C.) invites inquiries concerning the properties, composition, and functional characteristics of starch hydrolysates.

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"Corn in Industry" reissued. In response to continuing demand, a fourth edition of this 1952 booklet has been published by Corn Industries Research Foundation, Inc. The new edition of 64 pages has been revised and is pocket-sized; in two colors, with photos, drawings, and charts. Chapters on composition of the corn kernel, the refining process, and uses of resulting products occupy a major portion; a chapter on the importance of corn to defense reveals that its products are used in making hundreds of items of food, clothing, equipment, firepower, and medicine for the armed forces. History and backgrounds, the development of corn from a wild grass to the specialized hybrid varieties of today, and future potentials to be realized through continuing research, are outlined. "Corn in Industry" is nontechnical, designed as a teaching aid and as a reference work for agricultural and industrial libraries. Copies are free; write to "Corn" (quarterly leaflet), Corn Industries Research Foundation, Inc., 3 E. 45th St., New York 17, N.Y.